ENGINEERING NEWS

THE Poughkeepsie bridge over the Hudson river, commenced in Oct. 1886, was practically completed on Thursday, Aug. 30, by the connection of the last river span. The total length of the structure, including the shore approaches, is 6,777 ft., but the more important portion spaning the river is finished. Six months more will probably complete the approaches, of which there is yet remaining to erect about 2,700 ft. The connection of the last river span was fitly celebrated by the presence of the officers of the Union Bridge Company, the Chief Engineers of the Union, Manhattan and Poughkeepsie bridge companies and some invited guests. In the evening a collation was given to the 200 bridge employés at the Arlington in Poughkeepsie. The Union Bridge Company, who were the engineers as well as the contractors for building this important structure are to be congratulated upon the manner in which they have triumphed over many difficulties; and further, upon their able representatives on the work, Chief Engineer J. F. O'ROURKE and Messrs. WILLIAM and ROBERT BAIRD, who have proven their ability in the many trying circumstances attending the construction of this work.

THE Chicago & Northwestern Railway docks at Escanaba on Lake Superior are enormous both in the proportions of the docks and in traffic handled. This traffic is 1,800 to 2,400 cars daily, dependent upon the supply of vessels; there are 25 miles of track in the yards, requiring 15 switching engines and 500 men to operate the average of 128 trains per day using them. Besides over 2,000,000 tons of ore shipped here last year, there were 150,000 tons of coal and 30,000,000 ft. B. M. of lumber handled. The construction of the docks is similar to that at Ashland. The docks are 1,500 ft. long, 47 ft. 2 in. high and about the same in width, These docks are covered with wedge-shaped pockets 21 ft. deep, and these have an aggregate capacity of 35,000 tons, or 120 tons each; above these pockets are the railway tracks resting on a deck of 3-in. oak and provided with openings between the rails for the entrance of the ore, etc. At the bottom of each pocket is a door 3×4 ft. provided with a steel spout 36 ins. wide and 21 ft. long, which leads the ore from the bins to the vessel to be loaded. The docks are lighted by electricity and are protected by a system of fire hydrants. Besides the larger dock of 35,000 tons, there are three older docks of a combined capacity of 60,000 tons. In the week ending June 24, 101,522 tons were shipped in 80 vessels.

THE new Aqueduct Commission, through its committee on Finance and Audit, on Aug. 29, questioned some of the acts of the old Commission in the allowance to contractors for rock excavation outside the normal line originally fixed. The committee report admits that hard rock cannot be cut as with a saw or a knife, and that in blasting to a given line, rock may be taken from outside that line. But it believes that the contractor should have taken this fact into consideration in fixing his price on the paid section, and that the extra excavation is greatly dependent on the skill or carelessness of the workmen and the character of the explosives used. The Commission then adopted resolutions to the following effect:—That the report of this committee be submitted to the Corporation Counsel for his consideration and advice as to (1) whether the allowance of $585,498.85 made to contractors for tunnel excavation done prior to May 23, 1887, outside of the 12-in. brick lining masonry was lawfully made; and if not lawful whether this amount can and should be deducted from money now due to the contractors; (2) whether the Chief Engineer had the power to fix a line for tunnel excavation for work yet to be done and differing from the contract normal line; and if he had no such power, whether the $152,890,90 paid for this allowance since May 23, 1887, can and should be deducted from the retained percentage of the contractors. The present Commission then formally rescinded the resolution of the old commission of Dec. 30, 1887, defining and limiting the cross-section of the tunnel, and all other resolutions prescribing rules and methods for regulating the measurement of tunnel excavation.

THE Gatling Ordnance Co. has been organized with $1,000,000 capital to cast heavy steel guns on the new process of Dr. R. J. GATLING, the well known inventor of the gun of that name. The process is as yet secret, but it includes the gradual cooling of the metal from the core while the outside of the gun is kept at a high temperature. The patents also cover the use of certain other metals in combination with the steel, which it is claimed increase the strength and homogeneity of the material. The Hon. THEODORE MOSS, of New York is President of the new company. Work is to be commenced at once.

THE city of Baltimore is taking steps toward the removal of grade crossings CHAS. H. LATROBE has prepared plans for removing from the streets the tracks of the Northern Central Railway, which will be submitted to the City Council at its next meeting. All the tracks are sunk below grade and are enclosed with retaining walls, with parapet extending 4 ft. above the street level. The depth of the track below the street level is from 6 to 20 ft. Centre Street and Madison Street are to be carried across the railway by viaducts. A new station is also to be built. The total cost of the whole improvement is estimated at $800,000. Arrangements for the division of this expense between the city and railway company are yet to be made.

IT is reported that the Penna. R. R. Co. has decided to immediately begin the erection of five great shops at East Altoona, to cost $500,000. These shops are to have a capacity of 150 locomotives per year and will employ 1,600 mechanics.

AT the last meeting of the Forth Bridge Company the Chairman stated that the bridge would be finished in October 1889.

THE Mexican National Railway expects to close the break in its line northward some time this month. This will make another all rail route from the United States to the city of Mexico; but by way of the Gulf coast instead of El Paso.

THE first triple expansion pumping engine in this country is said to be the engine recently built by E. P. ALLIS & Co. of Milwaukee, for the water-works of that city. The duty guaranteed was 115,000,000 ft. lbs.; but the test is reported at 129,000,000 ft.-lbs., with anthracite coal and no deductions of any kind.

THE most serious railway accident of the week was a crossing collision at Lima, O., on Sept. 4. The west bound express of the Pittsburg, Fort Wayne & Chicago, consisting of baggage, express, passenger and vestibule cars, was an hour late and was approaching the city at a high rate of speed; a Lake Erie & Western accommodation train was on the crossing and the baggage car was struck by the engine of the express. Only one man was injured. The engineer of the express stated that he tried to apply the brakes at the usual distance from the crossing, but that they refused to act. The accident is very similar to the one at Chicago, reported in our issue of Aug. 25.——On Aug. 29 the boiler of a Lehigh Valley freight engine exploded, near Wilkes Barre, Pa. One man was killed.——On Sept. 3, some cars of a freight train on the Saginaw division of the Port Huron & Northwestern, ran off the track near the south approach of the Black River bridge at Port Huron, Mich., and the train ran nearly across the bridge before it was stopped.

THE following bridge accidents are reported; On Aug 27, the Credit River bridge on the Credit Valley division of the Canadian Pacific, gave way under a freight train and an engine and two cars fell into the river.——On Aug 27, a bridge on the Oregon Railway & Navigation Co.'s road, near La Grande, Ore., was badly wrecked by a runaway train with a derailed truck.——On Sept. 1, the false-works of the new Illinois Central bridge at Cairo, Ill., were swept away by drift in the river.——Bridges have been washed away on the Missouri Pacific in Texas, and also a bridge at Ambleside, Pa,——The Northern Pacific bridge at Bismarck, Dak., is reported to be in danger from a threatened land slide.

DURING the week there have been serious floods in Mexico, caused by continual rains. The cities of Leon, in Guanajuato, and Villa-Lerdo, in Durango have especially suffered.——In Canada, several washouts have occurred on the Canadian Pacific between Montreal and Winnepeg.——A cyclone struck Havana (Cuba) and a part of Florida, on Sept. 4.

EARTHQUAKES have occasioned much damage in New Zealand, according to London dispatches of Sept. 2. Five shocks were felt during half an hour. The spire of the cathedral in the town of Christchurch was destroyed and many other buildings were damaged.

TWO items in the annual report of the English Postmaster-General are worthy of note. One is tha of the 1,700 lines of wire entering the Central Tele graph Station in London not one is above ground the other is that during the year the number of telephone subscribers increased by 92, which as the correspondent of the New York *Times* well notes, "must bring the whole number of telephones used in Great Britain and Ireland fully up to the leve of Brick Church, N. J."

DR. ERNEST WIESENBAUER, Professor of Geology in the University of Heidelberg, has been investigating the natural gas deposits about Findlay, Ohio, with a very sensitive telephone apparatus. He thinks the extent of the gas field is underrated; and he concludes that there is about one mile of more or less non-conducting strata between a huge gas cave and a glowing furnace. He thinks this gas cave is of huge proportion and on an average not more than 1,200 ft. from the surface, and even less beneath Findlay. He also expresses the opinion that this gas might easily explode. It might be added that American scientists express grave doubts as to the correctness of the German professor's observations and conclusions.

PHILADELPHIA CITY COUNCILS has an amended elevated railway bill before it which may excite some interest; especially as rumor has it that the Pennsylvania R. R. Co. is interested in a new route of this character. Pennsylvania men, however, deny the rumor.

COL. MERRILL, Maj. STICKNEY and Maj. MACKENSIE, constitute a board of U. S. Engineers ordered to Pittsburgh to report on the continuance of the system of moveable dams on the Ohio river. This is in accordance with a provision in the last River and Harbor bill. The report is to be submitted to the next Congress.

The Kansas City cable road is using an electric light signal to warn people at Fifth and Main Streets of the approach of a cable train. When a train is coming a red light is shown and a bell rings. The device is claimed to be new and used here for the first time.

IN referring to an international steel rail pool, which English manufacturers are reported as trying to arrange with German and Belgian makers, the Berlin *Kuhlow's* says that English steel rail makers must first come to an agreement among themselves before suggesting an international arrangement. It thinks that this home agreement is unlikely in the present state of trade.

THE California State Harbor Commission, through its Chief Engineer, MARSDEN MANSON, reports that the use of canvas saturated with paraffine paint and covered with red-wood battens affords a protection against the teredo, if properly applied, for a considerable number of years. But it is not impregnable to rot. The most successful anti-teredo remedy of this character tried there is reported as that used by Col. MENDEL in building the Lime Point wharf 20 years ago. It consisted of ship's felt, coal-tar pitch and battens.

A NEW cable line has been laid between Cuba and Hayti, connecting Cuba with Porto Plata, San Domingo, Curacoa and Venezuela.

THE Krupp Works, at Essen, are to manufacture aluminium, after the process of Prof. NETTO, of Dresden. Cryolite from Greenland is to be the mineral used; and chemically pure aluminium is promised at the low rate of about $1.55 per pound.

Iron and Concrete Adapted to Resist Transverse Strains.

In a paper read before the Technical Society of the Pacific Coast in January, 1888, G. W. PERCY gives an account of the various experiments of THADEUS HYATT, of England, on compound iron and concrete beams, and discusses at length the new arrangement of the iron bonds proposed by recent experimenters on the Pacific coast, particularly the methods employed by Mr. JACKSON and Mr. E. L. RANSOME.

With the introduction of Portland cement, concrete construction became of more importance in modern building, until not only the foundations but the entire walls, arches, floors and roofs of structures have been made of it, and moulded trimmings and ornamental blocks are frequently cast and set in walls, taking the place of cut stone.

The cheapness of the materials composing concrete, its compressive strength, enduring and fire-resisting qualities, together with the fact that it can be prepared by unskilled labor under intelligent direction, make it valuable for permanent structures. Its low tensile strength and liability to fail under tensile or transverse strain without previous warning, has prevented its use for beams, lintels or floors, unless supported by iron beams or similar means.

About a dozen years ago THADEUS HYATT made a great many experimental combination beams of iron and concrete, using the iron in a variety of ways,—as straight ties, truss rods, flat pieces of iron placed either horizontally or vertically,—and with a great many styles of anchorage and washers. The conclusion arrived at was that iron and concrete could be so united in a beam that it could be depended on under all circumstances for its full tensile strength. The method selected by Mr. HYATT as best, was to use the tie iron as thin vertical blades near the bottom of the concrete slab, extending its entire length and bearing on the supports at both ends. These blades were anchored by round wires threaded through holes punched opposite each other, extending transversely and at intervals of a few inches. This made a sort of skeleton or grid-iron.

Although there seems to have been no defect in this system or failure in its application, this method has not been extensively used either in England or in this country, probably on account of the general disinclination to adopt new methods of construction.

In 1884 Mr. JACKSON, of San Francisco, made a test of a Hyatt light slab, 4 ft. 6 ins. square and 3 ins. thick. The slab had 19 wrought iron blades 1 x ⅛ ins. placed near the bottom of the slab, 2¾ ins. apart, threaded by 9 wires ¼ in. diameter, 6 ins. apart. The concrete was composed of one part Portland cement to two of sand, and 62 days old, supported by 3-in. bearings at each end, and loaded with pig-iron.

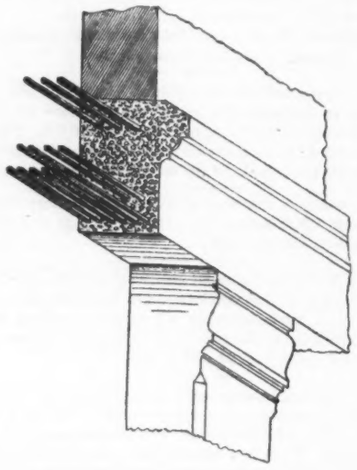
In loading the pig-iron, care was taken not to bond it by laying any bars in the direction of the length of the blades, and therefore the pile assumed somewhat a pyramidal form near the top, thus throwing more weight toward the center of slab. A fine crack was first observed when the load was about 20,000 lbs. and the deflection ⅛ in. This breaking load was equal to 2,000 lbs. per sq. ft., or safe load of 333 lbs. per sq. ft., with factor of safety of 6.

In another test Mr. JACKSON had prepared a beam 7 × 14 ins. in section and 10 ft. 6 ins. long. Near the bottom were seven vertical blades of iron extending the entire length; three of these were ¼ × 1 in. and four were ⅛ × 1 in., with ¼-in. wires threaded through every 3 inches. Near the top were bedded two cast-iron rope moulding bars, to assist the compressive strength of the concrete (an unnecessary precaution). The concrete at top and bottom, for about 4 ins., was one part cement to one of sand; center portion, one of cement to two of sand. The beam was supported by 9-in. bearings at either end, leaving 9 ft. in the clear. It was loaded with pig-iron piled across the beam, bonded only by thin hoop-iron. Mr. JACKSON expressed his belief that the beam would support 27 tons, and deflect 1 in. before breaking, basing his estimate on the assumption that the tensile strength of the hoop-iron used was 60,000 lbs. It broke under a load of 53,654 lbs., or 26.8 tons, by separating all the longitudinal blades on the line of one of the cross wires near the center. The deflection just before breaking was 1 5/16 ins. Fine cracks appeared at some of the wires near the center when the load was about 42,000 lbs. and the deflection ¼ in.

This breaking load of 53,654 lbs. was equal to about 6,000 lbs. per ft., or 1,000 lbs. per ft., with factor of safety of 6, which would evidently be a perfectly safe permanent load, as the deflection with 9,000 lbs. was too slight to be observed.

These experiments, Mr. PERCY says, together with the results of Mr. HYATT's tests in London, should satisfy the most skeptical of the practicability of obtaining the full tensile strength of iron as a tie in concrete constructions. The only objection to be urged against this method is, that by punching holes for the cross-wires the effective area of the tie metal is reduced, and the labor of punching holes and threading wires is quite an item of the cost.

Mr. E. L. RANSOME has devised a method of accomplishing the same results in which the objections mentioned above do not exist. The use of old wire cables, whose irregularity prevented their slipping, as a bond, suggested to him the idea of twisting square bars of iron or steel and imbedding them in the bottom of concrete girders or flat slabs, as shown in the accompanying illustration. The advantages of this method over any that preceded it are considerable. The twist in the bar would cause it to be held securely at every point along its length, instead of at intervals of several inches; no metal would be wasted by punching holes, and no extra iron required for anchors. The labor of twisting the cold rods would be but a trifle, and the entire sectional area of the iron could be placed just where it would be most effective.



Iron and Concrete Construction.

Moreover, it has been demonstrated by experiments that the process of twisting the bars strengthens, rather than weakens them. Mr. RANSOME immediately patented his improvement, and it is now quite extensively used in San Francisco.

Mr. PERCY continues thus:

A test was made of a slab 12 ins. wide, 6 ins. deep and 18 ft. long, composed of one part Portland cement to five parts gravel and broken granite, with six twisted rods ⅛ × ½ in. imbedded near the bottom. When about four months old, the slab was tested by being placed on blocks bearing 12 ins. at each end, leaving 16 ft. between bearings; loaded uniformly with sand piled on planks laid across the slab. Such a slab without ties could hardly be expected to sustain its own weight.

RECORD OF TEST.

Load.—Lbs.	Deflection in inches.	Remarks.
2,830	¼	= 1,830 lbs. to ¼.
3,640	½	
4,450	¾	
5,260	1	= 810 lbs. to ¼.
6,070	1¼	
6,745	1½	
7,420	1¾	= 630 lbs. to ¼.
7,960	2	
8,500	2¼	
9,040	2½	= 540 lbs. to ¼.
9,580	2¾	
9,985	3	
10,390	3¼	= 405 lbs. to ¼.
10,660	broke by crushing the concrete about 2 ft. from the center.	

The side split for some distance near the center of the fracture at about the neutral axis.

Another test was made, extending over several months, of a full size section of a sidewalk arch and beam, 5½ ft. wide, 15 ins. deep at beams and 6 ins. thick at center of elliptical arch, and 16 ft. between bearings. There was one ½ × 1½ in. twisted rod near the bottom on each side, forming the beams.

A total weight of 90 tons was piled upon a platform of planks, erected on the slab to give room for the weights. The result of this loading was the opening of several cracks, ¼ in. wide at the bottom and extending to within 2 ins. of the top; the deflection was 6½ ins. but the slab did not collapse. After standing several days in this condition, more weight was applied, and the concrete crushed near the center.

Concerning this remarkable result Mr. PERCY says:

Before analyzing the remarkable results of this test, let us consider the proper method of estimating the strength of such composite beams.

We must consider what is to be the effective depth of such a beam. It is evident the center of the tie-rods must be taken as the center of lower member; but the center of upper member is not so easily located, though it must lie near the top of the concrete.

It is evident that all the concrete above the neutral axis is subject to compressive stress—that stress being greatest at the top surface, and diminishing regularly to the center. It is also evident that as a beam deflects (and concrete, as it is well known, yields very little to compression) nearly all the strain must be met by a comparatively thin portion at the top.

It has appeared reasonable to the writer to assume the center of the top member as one-twelfth of the distance from the top surface to the tie-rods, and to consider that the concrete (one-twelfth of the depth) above and below this line must be sufficient to meet the compressive stress. Thus, if a beam is designed with a total depth of 15 ins., and the center of tie-rods placed 3 ins. above the bottom of concrete, it would leave 12 ins. as the entire depth from top surface to center of lower member. One-twelfth of this distance would be 1 in. as the center of top member, thus leaving as effective depth of the beam 11 ins., and the thickness of top member 2 ins. Then if a 1x1-in. bar, with tensile strength of 25 tons, is used for the lower member and concrete that would crush with 1 ton to the inch, at the top, the beam should have a width of 12½ ins. to equalize the strength of the iron.

Applying this rule to the sidewalk arch Mr. PERCY finds the theoretical breaking load to be 22½ tons at the center or 45 tons distributed load. As this result is obtained by using 20 tons per square inch as the ultimate tensile strength of wrought-iron bars, which will be considerably exceeded by good iron, we may add 25 per cent. to this result and assume that 60 tons load should break the rods. Such a load would, in this case, produce a tensile strain of 1.0 tons on 4½ sq. in. of section of iron, and a compressive stress of 120 tons on 132 sq. ins. concrete.

Mr. PERCY continues as follows:

As concrete does not yield to compression more than about one-thousandth part of its length before crushing, it is evident, that as deflection increases in beams of this construction the neutral axis must move upward or nearer the top member, thus making less proportional strain on the lower and more on the upper member. This was very apparent in this test, for when last seen by the writer the cracks due to extension had reached to within 2 ins. of the top of the slab, showing conclusively that the neutral axis must be still higher.

Now, while this may account very satisfactorily for the iron rods not breaking, as they then had a leverage of at least ten inches from the neutral axis, it does not account for the concrete not crushing, as the entire area of concrete then above the neutral axis could not be more than 100 in. and its greatest leverage about 1¾ ins. the stress would amount to the enormous load of 4.8 tons per sq. in. for 60 tons load and 7.2 for 90 tons. It is incredible that concrete of such quality could resist such stress for a moment.

It appears to the writer that some of the compressive strain must have been transmitted to the four thicknesses of plank forming the bottom of platform, and some of the load, by friction at the sides. If this be so, it renders this experiment worthless so far as the ultimate strength is concerned but could not affect the early stages of deflection. This arch and beam was designed to carry 400 lbs. per. sq. ft. or total load of 165 tons. When loaded to that extent its deflection was only about one-quarter inch. At this stage it could not have been relieved by the planks or the friction of sand on sides of curbing. The fact that such construction will deflect so much before breaking is a point in its favor, as it gives ample warning when it is overloaded. There have now been laid in this city about 50,000 superficial feet of sidewalk with spans

from 10 ft. to 22 ft. and there are no signs of failure or deflection under the heaviest loads that have been placed on them.

The writer has applied this system in a variety of ways. The lintels over store fronts are as shown in the accompanying illustration and have 15 ft. clear span to carry three stories of brick walls and wood floors, are of concrete 22 ins. wide, 2 ft. 10 ins. high (with belt course molded on), and have 10 one-inch rods near the bottom. These lintels extend along both fronts of the building, and over the supporting piers are placed three one inch iron rods near the top, thus giving the effect of a continuous girder, although they were not needed for strength.

In conclusion Mr. PERCY suggests that in the construction of bridges, dams, aqueducts and reservoirs, this method could often be used to very great advantage. In his opinion such structures as the Eddystone lighthouse could have been built better and for less money in this than in any other way, as there would have been no trouble in dovetailing the stones together, and the anchorage could have been made more secure by using twisted rods, extending them to any depth in the rock, and grouting with cement. It is now generally admitted on the Pacific coast that concrete foundations for heavy engines are better than almost any others. Mr. PERCY suggests that anchor bolts in such foundations, should be of twisted iron, thus securing a hold along their entire length, and not at the lower ends only. Moreover, iron so imbedded in Portland cement is perfectly protected from rust and fire and cannot deteriorate with age.

Standard Measures.*

BY E. A. GIESELER, C. E.

To measure the length of a line means to determine how many times the unit of length is contained in it. If the measurement is made by actual comparison of the unit with the unknown quantity, then it is called a *direct* measurement; if it is made by computation or construction, then it is called an *indirect* measurement.

On account of the imperfection of our instruments, as well as our sensual organs, direct measurements cannot be made absolutely correct, but will in all cases only be more or less close approximations to truth, the closeness of approach depending on the quality of instruments employed and the degree of care and ability with which they were handled. For these reasons, the direct measurement of a straight line, which is easy and simple in theory, present great practical difficulties when high degrees of exactitude are demanded. The primary requirement will always be the knowledge with the greatest possible exactness of the unit of length, a requirement the importance of which has been fully recognized only in modern times.

The original units of length were found in the arm, the palm, the thumb, the foot, the step, etc., and from these various dimensions of the human body many of the still existing units have been derived.

The actual employment of dimensions of the human body for the purpose of determining the unit of length is not, as one might be inclined to think, a matter of a very remote past, in proof of which I will quote a book on surveying, published in Germany, by JAKOB KOEBEL, about 340 years ago. In this book, the author gives the following instruction (accompanied by a wood cut, which is reproduced here), as to how the length of a foot is to be found:

"To find the length of a rood in the right and lawful way, and according to scientific usage, you shall do as follows: Stand at the door of a church on a Sunday and bid sixteen men to stop, tall ones, and small ones, as they happen to pass out when the service is finished; then make them put their left feet one behind the other, and the length thus obtained shall be a right and lawful rood to measure and survey the land with, and the sixteenth part of it shall be a right and lawful foot."

With such and similar crude methods to determine the unit of length, there could be no general concord in regard to it. Its length would be found different each time it was determined and a bewildering variety was the necessary result, which in many countries extends into quite recent days. In Italy, for instance, there existed in the year 1832, 215 foot measures of different length, and in Germany, at the beginning of this century, there were certainly not any less, probably many more. Some of these, with their lengths expressed in Parisian lines (144 lines to the Parisian foot), are given in the following table, from which it will be seen that the differences between their lengths in some cases are very considerable:

Table, rendering the length in Parisian lines, of some of the foot measures in use in Germany about 1790.

		Parisian Lines.			*Parisian Lines.*
1.	Thorn,	117.8	13.	Bremen,	128.3
2.	Cologne,	121.0	14.	Lippe Schaumburg,	128.6
3.	Weimar,	125.0	15.	Mecklenburg Schwerin,	129.0
4.	Saxony,	125.5	16.	Bavaria,	129.4
5.	Brunswick,	126.0	17.	Ulm,	129.5
6.	Frankfort,	126.2	18.	Oldenburg,	131.2
7.	Stuttgart,	126.8	19.	Augsburg,	131.3
8.	Hamburg,	127.0	20.	Halle,	132.0
9.	Danzig,	127.2	21.	Nurnburg,	134.7
10.	Dresden,	127.5	22.	Leipzig,	135.2
11.	Munich,	128.0	23.	Prussia,	139.1
12.	Strassburg,	128.2	24.	Vienna,	140.0

That such a chaos in regard to length measures could have been endured seems almost incredible now, but it must not be forgotten that in former

The Standard "Foot" of A. D. 1540.

times, when countries were less densely populated, and communication was difficult and slow, the importance of uniformity in this respect was not so universally felt as it is to-day. These remarks in a measure also apply to the United States, where during the Colonial and a great part of the Administrative period, many units of length existed, which were considerably at variance amongst each other. While from the very beginning of our history the old English foot was introduced inio the Colonies, and while we have therefore escaped the greater deviations that would necessarily have been incident on the independent creation of units of length in different parts of our country, we have not escaped the smaller deviations incident on inexactitude in copying the unit of length.

Hence, in a great measure, the perplexing difficulties and contradictions that are frequently encountered, when old surveys have to be referred to. In the surveys, for instance, made at various times of the land now covered by the city of Brooklyn, four different foot lengths have been employed, which are designated by Brooklyn surveyors as follows:

(1) The United States Standard:
(2) The Bushwick Standard:
(3) The Standard of the Twenty-sixth Ward:
(4) The Williamsburg Standard:

the difference between the longest and the shortest of them being about 2 ¼ ins. in 100 ft.

The city surveyor of Brooklyn, when laying out a lot, has therefore to measure with the standard employed in the survey of that particular vicinity, so as not to set himself at variance with the old maps and surveys. In one case, the non-observance of this rule has led to the following unique state of affairs: In a block which is 20 ins. too long, according to correct measurement, the lots have been laid out by starting from the two corners and measuring towards the middle with correct measurement. The result was that a strip of land 20 ins. wide, belonging to nobody, remained between two of the center lots. Houses have since been built on these lots, and between them still remains the ownerless strip of land, for which the city of Brooklyn cannot collect taxes from anyone, and which is therefore, from time to time, put up for sale on account of unpaid taxes.

The first attempts to regulate the question of length measures were made in France. In the year 1668, an iron toise (6 ft.) was inserted into one of the stone steps of the "Chatelet" in Paris, and this so called "Chatelet Toise" was accepted thenceforward as the standard measure of France.

About fifty years later, Newton became convinced, through his philosophical researches, that the form of the earth could not be a true sphere, but must be an oblate spheroid on account of the stronger centrifugal force at the Equator. If this was true, then a degree of meridian measured near the Equator could not be as long as one measured near the Poles, a deduction which was not corroborated by the actual geodetical measurements in existence at that time. In order to decide the dispute that arose in the scientific world on this question, the French government resolved to have measured two meridional arcs, one as near to the North Pole as possible, and the other in the vicinity of the Equator.

Two expeditions were accordingly sent out, one under Maupertius, to Lapland, and one, under Bouguer and de la Condamine, to Peru, each of them being furnished with an exact copy of the iron toise let into the stone step of the Chatelet. The Lapland expedition was shipwrecked on its return voyage, and on this occasion its iron toise was damaged to such an extent as to make it unfit for further use. The Peru expedition, however, returned with its iron measure in good condition, and the length of this so-called "Peru toise," at a temperature of 61° F., was now made the legal standard of France. The motive for this action on the part of the French authorities consisted in the fact that the proportion of the "Peru toise" to certain geodetical dimensions was known, and thus the idea of the natural standard was already fore-shadowed. It was clearly defined by the two leaders of the Peruvian expedition as a measure, based on some constant length to be found in nature, and related to the same in a simple proportion, which would easily and permanently impress itself on memory, so that if the measure itself, and even all written records referring to it were to be lost through some catastrophe, it might always be reconstructed by re-measurement of the natural constant on which it was based. Bouguer recommended to adopt for this purpose the length of the second pendulum on the forty-fifth latitude; Condamine, its length on the Equator.

Neither of these recommendations was carried out, and in the course of time they dropped out of sight entirely, until about 50 years later, under the reign of Louis XVI, when they were revived, together with a third proposition, namely, that of adopting the forty millionth part of the circumference of the earth, as the standard unit of length. After mature consideration on the part of the most eminent French scientists, this latter proposition was finally adopted, the main objection against the two first ones being that their adoption would carry the foreign element of *time* into the definition of the unit of *length*. In contradiction of the very common error that the metric system was given to the world by the French Revolution, it may be stated here, that the decision in regard to its creation and introduction was reached under the reign of Louis XVI, before the outbreak of the Revolution.

In order, now, to obtain the length of the natural standard decided upon, as accurately as possible, the French government ordered a measurement to be made of the meridian of Paris between Dunkerque and Barcelona. This work was executed by Mechain and Delambre between the years 1792 and 1798, and from the results of it the meridional circumference of the earth was deduced, and the forty millionth part of it was made the French unit of length under the name of "metre."

Measurements executed subsequently by Lambton, Mudge, Svanberg, Schmidt, Gauss, Bessel and others, and made by the aid of finer instruments than were at the disposal of the French scientists, have shown the earth's quadrant to be about 860 metres longer than found by them. In the strictest meaning of the word, the metre cannot, therefore, be looked upon as a natural standard.

The length found by Mechain and Delambre was deposited by them in the State archives at Paris in the shape of a platinum bar about one inch wide and one-quarter inch thick, the two ends of which were

*[Reprinted from the *Journal of the Franklin Institute*, August, 1888.]

one metre apart at the temperature of melting ice.

The careful construction and safekeeping of such actual standards is looked upon to-day as the real and only safeguard against the loss of the unit of length, while the idea of the natural standard is not any more entertained.

The modern standard measures are kept in places affording the greatest possible safety, and are never used for actual measurements, but only for comparing purposes, this even being done under strict regulations. The Imperial Standard No. 1, of Great Britian, for instance, is accessible only once in twenty years, while for the ordinary purposes of comparison a copy of it, No. 6, is kept at the British Standard's office, which is accessible at all times. The comparing of other measures with the Standards is done by means of instruments devised for this purpose, and called comparators, which will be described further on. There are two kinds of standard measures in use, viz: end measures and line measures. In the first-named the length of the unit is defined by the distance at a certain temperature between their ends; in the last-named it is defined by the distance at a certain temperature between two lines drawn on their surface at right angles to the direction of their length.

When comparisons are made, the measures are generally supported on rollers, and it is unavoidable that the weight of the bar causes a slight flexure between the points of support. The comparison is, therefore, not made as it should be, with the actual length of the bar, but it is made with the chord of the curve into which it has been bent. In the case of end measures the measurement is taken from the center of one end to the center of the other end; that is, the chord pertaining to the neutral axis of the bar is measured. In the case of line measures, the measurement is taken on the upper surface; that is, the chord pertaining to the upper fibres is measured. Now, it was supposed that the length of the neutral axis chord was the one most approaching the true length of the bar, and for this reason end measures were formerly considered preferable to line measures.

Aside from this, end measures possess an advantage in the greater facility with which comparisons can be made by means of them, an advantage which is, however, offset by the danger to which their ends are exposed of becoming damaged through the contact into which they are generally brought with peculiarly constructed levers during comparison. It is said that ethends of the platinum Standard metre of the Paris archives were damaged after a comparatively short time to such an extent as to impair the correctness of the measure. To prevent further damage, actual contact during comparison with this Standard has since been forbidden by law.

The only way to overcome this defect of end measures is by constructing their ends of a very hard material, that will not appreciably suffer under the contact with the levers of the comparator. As a noteworthy example of this kind, I will here mention the old Prussian Standard, made in 1837 by Bessel, and probably the finest end measure that ever was constructed. This Standard consists of a cast-steel bar of square cross-section, into each end of which is inserted a sapphire, ground in the shape of a frustrum of a cone, and set in gold in such a way that the smaller end of the stone protrudes a trifle beyond the end of the bar, and that the two sapphire ends are 3 ft. apart, at a temperature of 16⅓° C. Injury to the ends of this Standard is prevented by their extreme hardness, and a displacement of them through the rusting of the bar is prevented by the gold setting of the stones.

The difficulties incident on the construction of such a standard have led in our days to the very general adoption of line measures, to the discussion of which I now proceed, taking as examples some of the Standards that are kept in the Coast Survey Office at Washington.

The first Standard measure of the United States is a bronze scale 6 ft. and 10 ins. long, and subdivided on silver to tenths of inches, which has been prepared for the Coast Survey of the United States by Troughton of London. When this scale arrived in America it was subjected to a very close examination by Mr. HASSLER, then Superintendent of the Coast Survey, and as a result of such examination the yard comprised between the 27th and the 63d inch was designated as the one most conforming to the average of the whole scale. On the strength of this, such yard was adopted by the United States Treasury Department as a Standard at a temperature of 62° F.

In the year 1856, the British government presented to the United States two authentic copies of the British Standard of length, which are designated in Washington as:

Bronze Standard No. 11 and Malleable Iron Standard No. 57.

Both are bars of square cross-section and somewhat longer than a yard; in the vicinity of each end there is a circular hole sunk down to the center of the bar, into the bottom of which a small gold disc is inserted, on which are engraved five fine lines, viz.: two in the direction of the length of the bar and three at right angles to them. The length of one yard is defined by the distance from the center transversal line in one hole, to the center transversal line in the other hole, the parts of those lines to be used which are situated between the two longitudinal lines. The standard temperature was given by Mr. AIRY, the Royal Astronomer, for the bronze bar at 61°. 79 F., and for the iron bar at 62°. 58 F. The object of locating the graduation of these Standards in the neutral axis of the bars, was to eliminate the error resulting from flexure, which was discussed above.

In comparing the two authentic Standards with the Troughton scale, it was found that the latter was too long. The intention having been to adopt the English measure and the Troughton scale having been procured only with a view of getting an exact copy of it, it was now decided to introduce the authentic Standards received from the British government in its stead. This subject will be discussed more fully further on.

When measures constructed of different metals are compared with each other, then careful measurements must be made of their temperature, so as to take into proper consideration their different expansion. But while these measurements may correctly give the temperature of the surrounding atmosphere, they may, under circumstances, not give the exact temperature of the bars themselves. In order to obtain this value, which is eminently the one required in a direct and more exact way, Standards have been constructed, which form metal thermometers, on Borda's principle, and as an illustration of these, I will now describe the Standard metre, which was presented to the United States by the French government about 1850.

This measure is a planed and polished steel bar, the two ends of which are one metre apart at the temperature of melting ice.

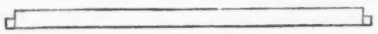


Fig. 1.

Upon each end of the bar there is screwed a small steel prism, reaching about half way across it, as shown in Fig. 1; the joints between the prisms and the ends serve as lines and the measure is therefore an end measure as well as a line measure. This steel bar rests upon a thicker and somewhat longer bronze bar, the two ends of which project beyond it, as shown in Fig. 2.

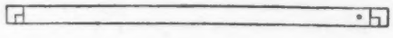


Fig. 2.

At one end the two bars are united by a pin, while at the other end they are free in their motions of expansion; to prevent any sideway deviations during these, there are four guide pieces attached to the underlying bronze bar, the top surfaces of which extend up flush with the surface of the steel bar.

One of the guide pieces at the free end of the bars bears a graduation and opposite to it the steel bars bear a vernier, by means of which the relative movements of expansion of the two bars can be read off to hundredths of a millimetre.

This system of bars was placed in melting ice and kept there for two hours; the vernier at the free end then read 4.42mm.

Then the system was placed in boiling water for two hours, when the vernier at the free end was found to read 3.80mm.

The difference of expansion between the two bars corresponding to a difference of temperature of 100° C. was, therefore, found to 4.42 — 3.80 = 0.62mm., for a length of 954 mm., that being the distance from the

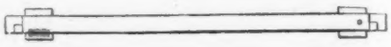


Fig. 3.

fixed point near one extremity to the zero of the vernier near the other extremity.

In order to determine the absolute expansion of each bar, an instrument was constructed by means of which a constant length could be inscribed on them. This instrument consisted of a steel beam compass, the two points of which were one metre apart at the temperature of melting ice, and which was constantly kept in a trough of melting ice, through the bottom of which its points protruded. The bars were now placed in melting ice for two hours and then the beam compass, always remaining in its trough, was placed on one of them in such a way that it rested lightly on one of its points, while with the other one a short arc of a circle was described; then this latter point was allowed to rest at the extremity of the arc just drawn and a similar one was described with the other point. Both the steel and the bronze bar, having been marked in this way they were now immersed in boiling water for two hours, and at the end of this time the process of marking on them the constant length of the beam compass was repeated in precisely the same way as before. The bars having lengthened under the influence of the higher temperature imparted to them the distance between the second two marks would, of course, fall short of the distance between the first ones, and the difference between these two lengths rendered the absolute expansion for each bar for a change of temperature from freezing point to 100° C.

The following results were in this way arrived at:

Expansion of bronze bar, corresponding to 100° C., 1.07030mm.

Expansion of steel bar, corresponding to 100° C., 1.0502mm.

The difference between the two absolute expansions is 0.6528mm., which renders 0.6228mm. for a length of 954mm., a result which agrees very well with the one found before by reading the vernier.

The coefficients of expansion corresponding to a change in temperature of 1° C., are

For the bronze bar, $B = 0.017030^{mm}$.

For the steel bar, $S = 0.010502^{mm}$.

The difference between the two, 0.006528mm., reduced to a length of 954mm., is 0.006228, which is the amount of change in the reading of the vernier for a change of temperature of 1°.

At the hand of these figures, it is now easy to determine the actual length of the steel metre for any given reading of the vernier. Let t be the temperature at which such reading is taken and let the following designations be introduced:

$M^0 = 1^m$ = length of steel metre at 0° C.

M^t = length of steel metre at t° C.

$l^0 = 4.42$ = reading of vernier at 0° C.

l^t = reading of vernier at t° C.

Then we have:

$$l^t = l^0 - 0.006228\,t$$

or

$$t = \frac{l^0 - l^t}{0.006228}$$

Introducing into this equation the value for t, which we obtain from $M^t - M^0 = S\,t$, wherein $S = 0.010502^{mm}$, we have:

$$M^t - M^0 = \frac{l^0 - l^t}{0.006228} S$$

or

$$M^t = 1^m + (4.42 - l^t)\frac{0.010502}{0.006228}$$

in which equation the second term on the right side gives the amount in millimetres to be added to one metre in order to obtain the actual length of the steel bar at a temperature of t° C. The amount of this temperature can be determined from the second equation given above.

Before leaving the subject of standard measures proper, their latest form should be mentioned, as devised by the International Commission on Weights and Measures, at Paris. This commission was created about 1870, and consists of delegates of

nearly all civilized countries. Under its supervision standard measures of length are made of a composition of platinum and iridium and furnished to applicants.

The shape of the cross-section of these standards, which is shown in the diagram, has been devised with a view of combining lightness and strength, so as to reduce to a minimum the error incident on flexure. In the line measures, the graduation is located on the plane indicated by a heavy line, and in the end measures the point of contact is in the center of the cross-section. As a matter of general interest, it may be added that the price of one of these standards is $2,500.

Fig. 4.

Having in the foregoing discussed various forms of standard measures, we now proceed to inquire into the appliances by means of which other measures are compared with them. Obviously there must be two classes of these comparators, one for end measures and one for line measures. The foundation principle of all of them, however, whether they belong to the first or to the second class, is the same, viz.: that of magnifying the exceedingly small quantities with which they deal, in a known proportion, to such an extent that they can be discerned and measured.

One form of the first class is based on an application of levers with long and short arms, as shown in diagram 5. The fulcrum of the lever *A* is connected immovably with the support on which the bar rests, while that of the lever *B* can be shifted by means of a micrometer screw with a graduated head. The long arm of each lever carries a vernier at its summit, moving alongside of a graduated arc and is pressed in the direction of the arrow by means of a light spring. When a comparison is to be made, then first the standard measure is to be placed between the short curved arms in such a position that the vernier of lever *A* is moved through the contact to the zero mark of its arc; then the fulcrum of lever *B* is shifted by means of the micrometer screw until its vernier also reads zero, and now the reading of the head of the micrometer screw is taken. Precisely the same operation is then gone through with the measure that is to be compared, and the difference between the two readings of the micrometer screw then renders the difference in length between the two measures.

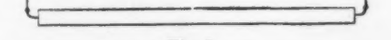


Fig. 5.

The support on which the measure rests is constructed in an instrument of this kind of two rules of different metals, one lying above the other and forming with it a Borda thermometer, similar to the standard metre described before. With the best instruments constructed on this principle, differences of the 1,000 part of a millimetre can be measured.

Another form of comparator consists in a sensitive spirit level mounted on a strong brass plate, which swings around a horizontal axis. Through the brass plate passes a micrometer screw with a graduated head, the lower end of which screw is brought into contact with the upper end of the measure, this latter being placed in an upright position and its lower end resting on a fixed point at the bottom of the apparatus. After the standard has been placed into the described position, the screw is turned up or down, as the case may be, until the spirit level indicates the horizontal position of the plate, when the reading of the graduated head is taken. The measure to be compared is then treated the same way and the difference between the two micrometer readings renders the difference in length between the two measures.

A very ingenious construction of a reflecting comparator has been made by Mr. SAXTON for the Coast Survey, and its main features may be described as follows:

When one end of the measure abuts against a fixed point, the other end, designated *A* in Fig. 6, is brought into contact with a small horizontal bar *S*, sliding between guide pieces and being pressed lightly by a spring, in the direction of the arrow, against such end *A*. To the sliding bar are attached two arms, connected by a small chain which winds itself around a vertical axis, carrying a mirror *m m*. The bearings in which this vertical axis revolves do

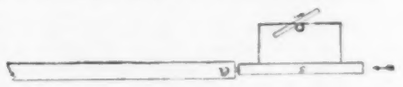


Fig. 6.

not participate in the sliding motion of the bar, and the occurence of such motion must, therefore, cause the mirror to turn with the axis to which it is attached. At a distance of about 20 ft. from this apparatus there is a graduated arc of a circle, the center of which is located in the vertical axis of the mirror. To the middle of this arc is attached a telescope, the line of collimation of which is perpendicular on the direction of sliding bar and measure and passes through the axle of the mirror (see Fig. 7).

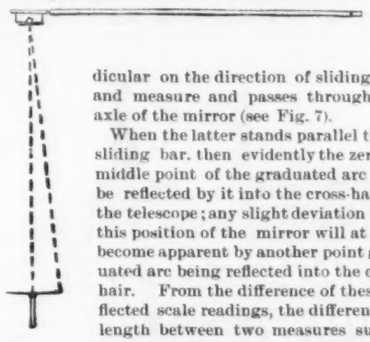


Fig. 7.

When the latter stands parallel to the sliding bar, then evidently the zero or middle point of the graduated arc will be reflected by it into the cross-hair of the telescope; any slight deviation from this position of the mirror will at once become apparent by another point graduated arc being reflected into the cross-hair. From the difference of these reflected scale readings, the difference in length between two measures successively, introduced into the apparatus is easily found, the limit of exactitude in the case of the Coast Survey instrument being the 25,000th part of an inch.

(TO BE CONTINUED.)

Aluminum Alloys by the Heroult Process.

The high tensile strength and ductility which aluminum imparts to certain other metals, such as copper, iron, etc., when entering into alloys with the same, have engaged the attention of metallurgists for some time, and it is safe to say that these valuable properties will insure the metal a large and ever increasing market just so soon as it can be produced at a moderate price. With a view to that end, the starting of the aluminum smelting works of which we are informed by a recent number of the *Schweizerische Bauzeitung*, appears to us to be a step in the right direction.

The Swiss Metallurgical Co., of Lauffen-Neuhausen, Canton Schaffhausen, Switzerland, is engaged in successfully producing alloys of aluminum on a large scale, making use of the Héroult patent process. This process consists in melting down certain refractory metallic compounds by the electric current and with the aid of certain electrodes, and in subsequently reducing the metals contained therein by electrolysis. The negative electrode is here the metal to be alloyed to aluminum, as, copper, iron, tin, the positive electrode being the carbons immersed in the molten alumina.

The current is supplied by two dynamos, each of 6,000 amperes and 20 volts, driven by a 300 H. P., Jonval vertical turbine, while a separate dynamo of 300 amperes and 65 volts is used as an exciter. The main difficulty to be overcome by the projectors of these works, was the production of a current powerful enough for the work to be performed. The enormous dynamos designed for this purpose, were constructed at the Oerlikon machine works, Switzerland, They make but 180 revolutions per minute. The magnetic field, having six poles, consists of a single casting weighing 11 tons for each machine. The armature used is constructed on the Brown patent design. Each machine is furnished with 2 large collectors and contains not less than 72 brushes. Copper cables of the size of a man's arm serve to conduct the current from the dynamos to the furnace.

The melting takes place in a crucible, or basin, of electrical carbon surrounded by a metallic wrapping into which the current enters (negative pole), the basin thus forming part of the circuit.

Metallic copper, broken up into small pieces is first placed in the basin (which is then covered up by means of plates of graphite, care being taken to fill up all open joints with powdered charcoal. In the center of the graphite cover, a space is left for the introduction of the suspended carbon slabs to which the positive cable is affixed.

The carbons are then lowered towards the copper which is soon melted by the current passing through it. Alumina is now added to the copper through locks arranged for that purpose, while the carbons are somewhat raised. The current passing through the alumina melts and reduces the same, the oxygen burning the carbon and escaping as carbonic oxide gas, while metallic aluminium becomes alloyed with the molten copper. By drawing back a carbon stopper, the contents of the basin may now be emptied out into a ladle or ingot. The basin is then recharged after the manner above described, making the process a continuous one.

As mentioned above, the position of the carbon slabs in the basin requires to be regulated according to the resistance. This may be accomplished by an automatic device in this form of a chain holding up the carbons is connected with a reversible dynamo electric motor regulated by the amperemeter.

The intensity of the current found to be best adapted for the process, is 12,000 to 13,000 amperes, the electro-motive force being from 12 to 15 volts, though it was found that the output of the dynamos could be easily increased to 25,000 amperes without causing any disturbance to the same.

The same process may be followed for obtaining all other alloys of aluminium, excepting those metals which become volatilized at the melting point of aluminium.

Mixed alloys, too, may be directly produced by this method i. e., copper, silicon and aluminium by melting down clay containing silica as well as alumina.

The capacity of the plant above described is stated to be 660 lbs. of aluminium per day or 6,600 lbs. of bronze containing ten per cent. of aluminium. The heats may be continued day and night for months without stopping.

A series of tests, made by Professor TETMAJER, of the Polytechnikum at Zurich, illustrating the high tensile strength and ductility of the products of these works, will be of general interest to our readers.

Metal.	Tensile strength (in lbs. per sq. in.)	Elongation (per cent.)
Aluminium bronze "A"	49200	25.4
" B	54600	27.4
" C	51760	34.3
" D	68200	37.5
" E	73380	39.2
" F	79630	23.0
" G	88300	18.5
" H	91000	7.0
Aluminium brass	68400	20.7
* Gun steel	78200	14.0
* Wrought iron	54000	22.0
* Delta metal	54000	20.0
* Common bronze	32700	8.0
* Phosphor bronze	41240	17.0
* Manganese bronze	41240	17.0
* Durana metal	51200	22.0

The tests marked thus * were made by Professor TETMAJER for the purpose of verification.

It should be remembered that all test pieces used, of aluminous alloys, were *cast* and turned in the lathe. It is generally known that aluminium bronze may be forged, upset, rolled and made into wire. The alloy called aluminium brass is valued for its hardness and ductility. Another alloy, ferro-aluminium, when added to steel in minute quantities facilitates the flow of the metal and keeps it free from bubbles. In making ferro-aluminium, the same process above described is followed, iron simply taking the place of copper.

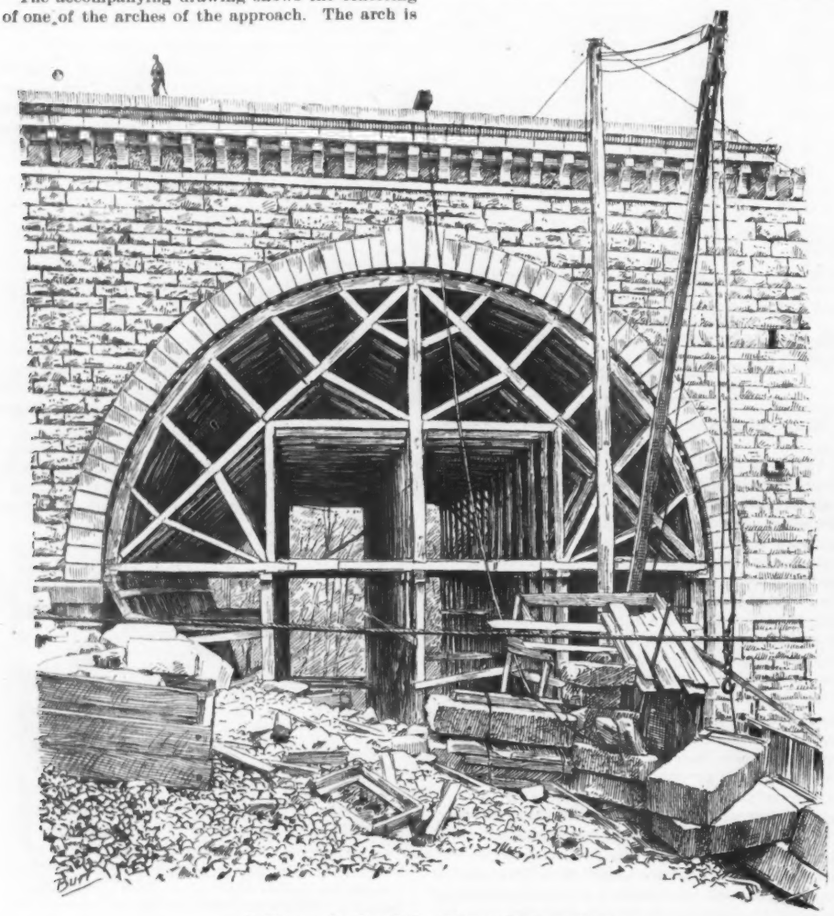
We can but regret that our source of information fails to mention the cost of production per pound of metal. As the dynamos are driven by water power the renewal of the carbons burned by the chemical processes taking place in the furnace, would seem to be the only source of running expense. When we consider that the selling price of aluminium is at present $12 a pound in Europe, the plant here described yielding an output of 660 lbs. per day ought to be able to produce the metal at a cost far below the present figure. The amount of aluminium in its alloys with copper averaging only 10 per cent. while iron and steel require only one-tenth of one per cent. to receive the full benefit of the combina

on, it cannot be doubted that at the reduced price which must result from the new process, a large market will be sure to open to aluminium and its alloys.

Manhattan Bridge.

The new great arched bridge which crosses the Harlem river at 181st St., this city, is rapidly nearing completion. The metal work is all done with the exception of the railings, the posts of which are partly in place. On the western aproach considerable work is yet to be done in rock excavation to meet the grade at 10th Ave. The parapet is laid on the main abutment and on two-thirds of the approaches. Of the sidewalks about one-third has been laid. The roadway is all to be paved. The bridge will probably be finished some time in November.

The accompanying drawing shows the centering of one of the arches of the approach. The arch is



A Shore Arch of the Manhattan Bridge.

semi-circular, 60 ft. in diameter and 80 ft. The timbers in each panel of the centering may be described as follows: the bottom plate is 10×12 ins.; the center post is 12×12 ins. ×27 ft.; the side posts 10×10 ins. ×14 ft.; the upper horizontals are 10×10 ins. ×14 ft. diagonals and braces are 10×10 ins. The semicircle is composed of three planks 4×14 ins. Oak wedges were used. No attempt was made to strike the centers, and they fell away from the masonry owing to the natural shrinking and settling of the timbers.

HARDENING WOOD.—According to *Iron* a newly invented process of hardening wood is being turned to practical account by the Germans. The process consists in steeping the wood in a bath of caustic alkali for 2 or 3 days at a temperature of about 180° Fahr. after which it remains for 2 or 3 days in a bath of hydro-sulphate of calcium. The process is completed by a bath of acetate of lead at a temperature of about 110° Fahr. Wood thus treated has many of the properties of metal and is susceptible of a very high polish but is lighter and unaffected by moisture.

The Mississippi River and Storage Reservoirs.

In response to the request of the Chamber of Commerce of New Orleans, Maj. J. W. POWELL, has lately written a letter explaining the beneficial effects of the proposed storage and irrigation works on the western head waters of the Mississippi river upon navigation and agriculture in the lower Mississippi valley. Briefly stated the reasoning of Maj. POWELL was as follows:

To control the lower Mississippi is a problem of great magnitude: and to give the channel stability and sufficient depth and breadth to enable it to transport to the sea all flood water, as in a perfect conduit, several things are necessary, (1) to prevent the choking of the channel by excessive sedimentation; and (2) to diminish the volume of the floods by the storage of water above in the flood seasons. This storage water may also serve to irrigate the arid lands on the Eastern slope of the Rocky Mountains.

The Mississippi and its tributaries receive and transport to the sea the drainage of about 1,250,000 sq. miles; or about 675,000 cu. ft. per second pass New Orleans; or 150 cu. miles per annum.

The average contribution in cubic feet per second of its principal tributaries, in round numbers, is as follows: Upper Mississippi, 100,000 cu. ft.; Missouri, 120,000 cu. ft.; Ohio, 160,000 cu. ft.; St. Francis, 30,000 cu. ft.; Arkansas and White rivers, 60,000 cu. ft.; Yazoo, 40,000 cu. ft., and Red river, 60,000 cu. ft. per second. A portion of this grand total poured into the valley below Cairo, escapes through the Atchafalaya and other bayous even at average stages of the river; but probably not less than 80 per cent. finds its way to the Gulf past New Orleans. During flood stages the outflow by the latter route rises to about 1,000,000 cu. ft. per second, but the inflow into the valley at such stages may exceed twice the carrying capacity of the main branch and the Atchafalaya. Of the three main branches, the discharge has been found to rise during floods in the Upper Mississippi and Missouri to three times, and in the Ohio seven times the average discharge.

Observations show that near New Orleans the amount of sediment in transport varies from 1-800 to 1-7000 part of the total volume, and averages about 1-2000 part of that volume. Above the mouth of the Missouri the Mississippi carries an average of only 1-4500 part of the volume. But the Missouri just above its junction with the Mississippi carries from 1-200 to 1-5000 part of sediment with an average of 1-700 part of the volume. Though direct measurements have not been made, observations on the Ohio indicate that it is comparatively free of sediment. The load of sediment brought in by the minor tributaries below Cairo and that carried off by the Atchafalaya are unknown. But Major POWELL concludes that it is safe to estimate that from 1-2000 to 1-3000 of the total discharge into the Gulf is mud, and that the Missouri furnishes from 40 to 60 per cent. of this mud.

The average discharge of sediment from the Missouri is, in round numbers, 170 cu. ft. per second, or 500,000 cu. yds. per day, or 180,000,000 cu. yds. per year. And at flood stages the discharge of sediment has been observed to be as great as 4,000,000 cu. yds. per day. This latter is the equivalent in volume to a levee with 100 sq. yds. in cross-section and 23 miles long; or 1,000 miles of such levee in one year.

The effect of this sedimentary load on the course and character of the river is great, and the principle is generally accepted that the cutting power of a stream increases rapidly with the increase in sediment transported. A stream with a clear flow cleans and maintains a fixed channel; while a stream gorged with sediment brings about unstable equilibrium; it cuts away its banks here, and piles up sediment there, changing the channel constantly, and during floods the burden of the water is unloaded on the adjacent lands. This action is very apparent along the Mississippi and Missouri valleys.

Major POWELL states that the prime end to be sought is not the diminution of the volume of water in the lower Mississippi; but it is to prevent the choking of the channel and thus avoid destructive floods. The storing of the flood waters on the Ohio and Upper Mississippi would at first relieve the lower flood plain; but on the other hand the choking of the lower channel would afterwards progress at an increased rate, and this storage would ultimately increase the dangers. But the storage of the waters of the Missouri and other sediment-charged tributaries, so as to deposit this sediment on the plains, would permit the purer waters to open a sufficient channel for themselves and thus to protect the Mississippi. The real problem is to relieve the water of its excess of sediment and thus prevent lateral cutting and promote vertical scouring.

A SIMPLE FILTER.—"For a long time I have used in my butler's pantry a simple contrivance for filtering water used on the table, which has been so serviceable, and at the same time so inexpensive, that I venture to recommend it. I took an ordinary glass pharmaceutical percolator, and packed the outlet with absorbent cotten so tightly that the water could only flow in drops. By means of a piece of copper wire for a bale, it was suspended from a hook on the lower side of one of the pantry shelves, over the shelf of the sink. As often as necessary, water is poured into the percolator, and the water-pitcher is placed under the outlet. Whenever the cotton shows much discoloration—a thing which is easily observed, owing to the percolator being of glass—the maid replaces it with fresh absorbent cotton. It is in all respects the most practical and cheapest filter I know of, and has no machinery to get out of order, no patent right to carry, and the advantage over most filters that the filtering medium is always under observation, so that there is little risk of contamination of the water by accumulations of filth."—Dr. F. A. Castle, in New York *Medical Journal*.

THE London & Northwestern Railway has decided lately "in deference to the prejudices of its American customers," to institute the system of checking baggage. It will keep up the practice after it is once well started, we predict, in deference to the prejudices of its English customers.

The Steam Buggy.

As there is just now an epidemic of magazine articles devoted to the evolution of the locomotive and railway plant generally, we feel called upon to add our mite to the common fund; and we do this by submitting to our readers the "steam buggy", a specimen of the genus locomotive which has so far escaped attention in the general history referred to. The original of our sketch is a colored caricature published in London on Jan. 1, 1828. But in its essential features it fairly suggests what was just then the popular fancy in regard to the new steam locomotive, and the tendency of much inventive genius.

The famous trial of locomotives on the Liverpool & Manchester Railway did not take place until nearly two years after the appearance of this "prophecy"; and in 1827, it was still a matter of much doubt whether a railway could be produced capable of superseding the coach road for purposes

H. Alken's Illustration of Modern Prophecy, or Novelty for the Year 1829.

I say Fellow; give my Buggy a charge of Coke, your Charcoal is so D_d dear.

THE PROGRESS OF STEAM.

of transport of passengers and freight. Many inventors then only sought to utilize the roads they had by the simple substitution of steam for the horse as a motive power; and the public very generally looked forward to some such practical result of the introduction of the "iron-horse" as that which forms the subject of our illustration.

The earliest record of a carriage propelled by steam on a common road is a crude experiment made by NICOLAS JOSEPH CUGNOT, a French army officer. He is said to have constructed a working model in 1769, and another in 1770; the latter being still preserved in the Conservatoire des Arts et Metiers, in Paris. JAMES WATT was experimenting in this direction in 1769, as was also the American OLIVER EVANS at about the same date. WILLIAM MURDOCK, Watt's assistant, actually made in 1784 a model of a locomotive driven by a "grass hopper engine" with a steam cylinder ¾-in. in diameter and 2-in. stroke. Contemporary gossips tell us that as MURDOCK was experimenting with this locomotive one dark night, it ran away from him down a narrow country lane, and meeting the village parson in its mad rush, it thoroughly convinced that good man that he had indeed encountered the Evil One. But after CUGNOT'S time the first road locomotive which seems to have done any practical work was the "Oruktor Amphibolos" of OLIVER EVANS of 1804. This was a flat-bottomed boat mounted on wheels; the same engine drove it through the streets of Philadelphia to the river bank, propelled its paddle wheels in the water and also operated a dredging outfit with which it was equipped. EVANS patented his road engine in 1784, and immediately thereafter tried to introduce it for the transport of flour on the roads leading to Western Pennsylvania. But the State Legislature practically voted that his ideas were absurd, and that no sane man would suggest the substitution of an "iron-horse" on the highways of that State for the solid flesh-and-blood animal so much more familiar to the members of that august body.

The idea seems to have been then practically abandoned until locomotive and railway experiments again opened the field, and such technical journals as existed about the beginning of the third decade of this century began to describe and discuss various more or less satisfactory attempts at the creation of an "iron horse"

Among the earlier of these ventures was the steam-coach of W. H. JAMES, Esq., and Sir JAMES C. ANDERSON, which will be found illustrated and described in the London *Mechanics' Magazine* of Nov. 14, 1829. This coach is said to have been invented in 1824-25, and in its general arrangement probably suggested to Mr. ATKEN the "buggy" shown in his caricature. For while the body is a coach capable of seating 4 to 6 passengers, there is a driver or "steersman" perched on a regular driving box in front and a guard in full costume figures on a rear box. We are told that the four engines attached to the two driving wheels were so simple and compact that "one could be stowed in each coat-pocket"; but with the characteristic caution of one seized with a grand idea, these engines are neither illustrated nor fully described. The vehicle was turned by the "steersman", who controlled a valve that would simultaneously let more steam on the engines on the outer wheel and shut it down on the inner pair, and thus by the difference in speed cause a change in the direction. In a trial trip from Vauxhall Bridge to the Swan, in Clapham, this vehicle, weighing under one ton including fuel and water, traveled the 2¼ miles in 10 minutes; or, about 15 miles per hour. JAMES and ANDERSON promised to regularly carry the mails in October, 1829, but apparently failed to realize their good intentions for reasons not stated.

In March, 1831, Sir G. GURNEY appears as the inventor of a road-wagon, which wagon from contemporary accounts, seems to have been the nearest approach to a practical success of any then before the public. At this time he was making daily trips on the coach road between Cheltenham and Gloucester, a distance of 9 miles; and with 10 or 12 passengers, he frequently made the journey in 40 minutes, or at the rate of 13½ miles per hour. The London *Times*, of May 12, 1831, congratulates the public on the successful introduction of this new road motor, and gives as one of the practical results of the new invention, the fact that it had reduced stage fares from 4s. to 1s. GURNEY, later, towed a coach body behind his road-wagon, and thus carried 33 passengers over the 9 miles in 50 minutes. He ran his wagon for 4 months and carried about 3,000 passengers, and then attempted to introduce it between Edinburgh and Glasgow and Birmingham and Bristol. But the success of the trial at Rainhill, the speedy extension of railways and the difficulties attending the adaptation of a road-engine to the many conditions of country roads, caused a cessation of effort in their improvement until about 1856, when inventors began to produce the modern steam road-roller and other engines of that class with which we have nothing to do here.

The list of inventors interested in road engines, other than those mentioned above, is a long one; and more or less incomplete accounts have reached us of steam carriages invented by JULIUS GRIFFITHS in 1821, Messrs BURSTALL, HILL and BRAMAH, of London and Edinburgh; and Messrs, SEAWARD, Sir CHARLES DANCE, WALTER HANCOCK, OGLE, SUMMERS and others in various parts of Great Britain. In America, we find the names of HARRISON DYAR, JOSEPH DIXON, RUFUS PORTER and Mr. JAMES as inventors who attacked this problem with more or less success.

It might be mentioned that the Cincinnati *Commercial Advertiser*, in 1830, describes a "steam-coach" that was made in that city by SHIELDS & SON. The engine, independent of the boiler, only occupied a space of 2 ft. × 1 ft. × 1 ft.; but it was claimed to be powerful enough to ascend a grade of 45 ft. per mile and to travel over a good road at the rate of 14 to 16 miles per hour. Aside from this rather unsatisfactory notice, no further account of this engine is known to us.

In looking over the technical magazines of 1829-30-31, etc., it is very evident that the uncomfortable possibility of an exploding boiler was not disregarded, either by the inventors, or in anxious inquiries from the public which hoped soon to race over the country roads astride an iron cylinder filled with live steam—as in the case of the elaborately attired dandy of the day seen to the right of our illustration. The proximity of hot iron to the person of the user, and the effect of escaping smoke and steam on horses of the flesh-and-blood order were also matters freely and somewhat amusingly discussed, from the standpoint of 50 years later.

Pile Creosoting in San Francisco.

Chief Engineer MANSON, of the California State Harbor Board, has recently made a report on the creosoting plant at San Diego, Cal. After describing the works, which he says are small and not equipped with the best machinery, he proceeds to give some items of cost. He says, the consumption of creosote (delivered at 14 cts. per gallon) is 3 160 galls. for 3,318 lineal feet of piling; or, about 9-10 gall. to each lineal foot. The treatment including labor and material costs 18½ cts. per lineal foot of pile. This does not include the cost of loading or shipping, but does include handling in the yard. The piling itself costs 26 cts. per lineal foot at San Diego. As to duration of creosoted timber, he says that the National City wharf was built of creosoted piles in 1883. The wharf was built of round piles, 12 × 12 in. timbers and 3 × 4 in. braces. The penetration of the creosote was from ¼ to ¾ in. The round piles are in good condition, but the square timber is generally bad. San Diego bay is not so much infested by the teredo as the San Francisco waters, but the limnoria is there and much more destructive. The piles in the National Wharf showed no indication of attack by the teredo: but in many instances they were hollowed out by rot, leaving only a creosoted shell untouched. In concluding his report Mr. MANSON said that creosote oil can be laid down in bulk in San Francisco at 10 cts. per gallon, and the San Diego works could be duplicated for about $6,000.

THE latest ship canal scheme is one to connect the Bristol and English Channel ports. It would commence at Stalford, on Bridgewater Bay, and pass via Taunton to Seaton on the East Devon coast. The length would be 45 miles and the saving in distance would be 300 miles. The canal would have a capacity equal to the transit of vessels of the largest tonnage, and the cost is roughly estimated at $350,000 per mile. The cost of land etc. is not included; that and other trifling items are left to be handled in "a prospectus shortly to be issued."

Railways in America in 1831.

The London *Mechanic's Magazine*, for March, 1831, contains the following on the "Progress of the Railway System in America":

RAILWAYS COMPLETED.

	Miles long.	Cost per mile.	Track.
Manchester	13		Single
Quincy	5	$11,000	"
Mauch Chunk	9	3,050	"
Schuylkill	13	7,000	Double
Mill Creek	4	3,500	Single
Mount Carbon	9	11,000	Double
Schuylkill Valley	10	5,500	"
Lateral to above	13	2,600	Single
West Branch	15	10,000	Double
Laterals for above	5	2,000	Single
Lackawaxen	16	12,000	(including engines, etc.)
Total	110 miles.		

RAILWAYS IN PROGRESS.

	Miles long.	Estimated cost per mile.
Albany & Schenectady	18	
Camden & Amboy	65	
Columbia	84	$15,000
Alleghany	38	25,000
Likens Valley	16	
Little Schuylkill	18	
New Castle & Frenchtown	16	
Petersboro & Roanoke	60	
Baltimore & Ohio	340	$22,000
Balt. & Susquehanna	60	
Charleston & Hamburg	150	$6,500
Lexington & Ohio	80	
Detroit & Pontiac	25	
Louisiana	4	
Total	974 miles.	

The Boston *Mechanic's Magazine*, of the same year, or 1831, speaks as follows of the Baltimore & Ohio railway: "The first 13 miles to Ellicott's Mills is furnished with a double track. A single track is laid down 12 miles further, and the whole line to the valley of the Potomac (upwards of 60 miles) is in progress and expected to be completed by the end of the ensuing year, and 50 miles per annum, until the whole is completed.

"The actual cost for gradation and masonry, of the first 13 miles, was more than $46,000 per mile. It was expected that this would be the most expensive part of the route, but nothing like what has been incurred.

"In consequence of a change in the location of this part of the road, a very great increase in the amount of excavation and embankment was rendered necessary. Substituting stone for wooden bridges, and finishing them in a style altogether incompatible with the dictates of that economy which is indispensable to the successful prosecution of work of this kind, together with a want of concert among the directors and the engineers, are the principal causes of this increased expense.

"The single work called the Patterson viaduct has 10,000 perches of masonry in it. It is built of hewn granite blocks of from 1 to 7 tons each. The height from the water to the arches is 30 ft. It may and in fact is, said to be 'truly a great work—an immense structure—creditable to the enterprise and public spirit of the company, and to the skill of the engineers'. All this, however, may with equal truth be said of the mausoleums, obelisks and pyramids of Egypt. But after all, it has more of sound than substance in it.

"Directors and engineers of works of this kind ought to feel that every dollar expended for show and elegance is worse than lost; for it goes directly to retard or prevent the completion of their own enterprises, and to discourage all others of a similar kind.

"The interest of the money expended on this viaduct would probably be sufficient to erect a wooden bridge every year, which would last, almost without expense, 10 or 15 years.

"As the immense expense of the first 13 miles has had a great effect in damping the zeal and ardor in relation to similar enterprises in other parts of the Union, and particularly in this, I subjoin a few extracts from a recent report of the directors in relation to other parts of this road.

"The whole cost of gradation and masonry from Baltimore to Ellicott's Mills was $46,496 per mile. The next division, extending to the forks of the Patapsco, and now nearly completed, it is ascertained, will cost $10,022 per mile. The third division, to Parr's Spring Ridge, will be but $7,001 per mile. In fact, it has been satisfactorily ascertained that the gradation and masonry of the first 10 miles has cost more than the next 56 miles will cost.

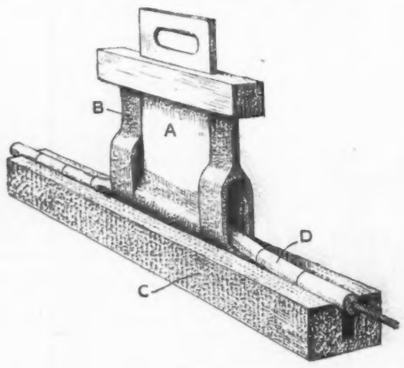
"Great confidence is still felt by those most competent to judge correctly, in relation to this enterprise, that this road will yet be completed at an expense within the original estimate; Say $22,000 per mile for a double track."

The Lowrie Cover for Cable Conduits.

The illustration given herewith shows the cover for cable conduits invented by City Engineer H. C. LOWRIE, of Denver, Col., and several times referred to in these columns.

The purpose of this invention is to cover the cable slot and thus prevent the entrance of any obstructing body. As described, this cover is made by stringing cast-iron shells, 4 in. long, upon a small steel wire cable, with the joints between filled by pure-gum rubber washers. The cover so made weighs only 3 lbs. per lin. ft., but 2½ ft. are lifted at one time. The total rise above its seat at any one time, except when the cable is entirely dropped, is less than one inch.

The claims are made that this cover protects the slot effectually and cannot get to either side, or bind; that it is flexible and sufficiently heavy; that the friction involved will be inconsiderable and no more than sufficient to keep the metal bright and clean; that each passage of the car will wipe and clean the cover the whole length of the route and that it is noiseless.



Lowrie Cable-Slot Cover.

In the model shown, *A* represents the grip-plate; *B*, the grip-shank; *C*, the slot-rail and *D* is the cover with its shells. The cost of this cover including all changes in the grip is said to be less than $1,000 per mile in new construction.

CORRESPONDENCE.

Destructive Force of Colliding Trains.

SCRANTON, Pa., Aug. 8, 1888.

EDITOR ENGINEERING NEWS:

In reply to the reference in your last issue, which your correspondent L. C. F. makes to my previous communication (August 4th), I would say that I think the formula which I there give is the proper one for the determination of the destruction of vis viva in colliding bodies.

If the problem be worked out for the collision of two trains of equal weight, it will be found that if they meet when each is moving with a velocity of 30 miles per hour, the destruction of vis viva is double that which would ensue if one were stationary and the other moving with a velocity of 60 miles an hour.

In my second communication (August 11th) I endeavored to show that the reason why the destruction of vis viva was greater when both trains were in motion, than when one was stationary and the other moving at a double velocity (equal however to the *relative* velocity in the first case), was that in the first case there was a total arrest of motion, while in the second both trains moved on (theoretically) in the direction of the moving train, after the collision.

In my communication of August 4th, I find that the value of the relative velocity V is printed equal to $v+v'$, instead of $v+v'$. G.

The Cascade Bridge and "Reservoir Dam."

Dept. Public Works, 31 Chambers St.,
NEW YORK, Sept. 1, 1888.

EDITOR ENGINEERING NEWS:

In your issue of July 28, in advocacy of rock filled dams, under certain conditions, you instanced the closing of such dams by silting up, and refer to the unlooked-for experience on the Erie R. R. at the Cascade bridge, where what used to be called the "French drain" principle, proved to be a reasonably tight *dam*. Permit me as the one who located that line of road, designed that bridge, as also the neighboring Starrucca viaduct, to say a few words on the early history of these structures, of interest possibly to some who see it for the first time in print.

The Cascade creek is an affluent of the Susquehanna river in Broome Co., N. Y., a short distance north of the Pennsylvania State line, and opens by a high fall into a deep glen with rock banks, draining some 20 sq. miles of quick mountainous water-shed. It is an insignificant stream ordinarily, but during a sudden thaw it is estimated to have delivered at the rate of between three and four hundred million gallons in 24 hours.

When the Erie Railway applied for State aid in 1846, a Commission was appointed by the Legislature to examine and report between the Nineveh or "interior route", and the Susquehanna or "river route" the latter passing into Pennsylvania by the Great Bend of the Susquehanna. They reported in favor of the latter route, notwithstanding the fact that the grade from the summit westwardly for a distance of 6 miles, was 68 ft. per mile, while the interior route presented nothing over 65 ft., but with other objectionable features; so that when the engineer of the Erie came on the ground, and declared that a grade of 60 ft. could be had in lieu of 68 ft., the ruling maximum grade throughout the line elsewhere being but 60 ft., the company at once authorized its location. This uniform grade from the summit going westwardly, did not permit of selecting the point of crossing the Cascade creek, but compelled a crossing *below* the falls, where the ravine was some 500 ft. in width, and 175 ft. deep. So much for the *why* the line was located below the Falls. There remained to determine *how* it should be constructed. It was very difficult at that date to carry any project looking to any ulterior benefit, on broad engineering principles, but economy in first outlay, owing to the financial condition of the company, was a recognized principle of good "location", as was also the necessity of first opening a *single track road to Lake Erie*, regardless if in so doing an additional expenditure was thereby thrown on the construction of the second track.

The policy of the management, to keep all heavy grades if possible, down to the existing maximum grade of 60 ft. per mile there, and for some years in operation on the eastern division of the road, had resulted in forcing the line, from the Gulf Summit westwardly, to encounter an expensive obstacle. There remained to overcome it as judiciously as possible in construction. The Cascade creek itself called for nothing like the water-way afforded by a bridge, yet by using the rock sides as a natural abutment (such as is seen we are told in many places in Central Park) it was estimated that a framed timber arch of 275 ft. span could be built, for a far less sum than could any other method of crossing the ravine. No permanent crossing could have been effected at that time for less than $120,000. In making this estimate, it is true that there was no one around, possessing sufficient hardihood as to lift his voice in advocacy of a tunnel through one of the banks. The youngest among them, if indeed there were any in such a callow state as to entertain the idea, rated his position too highly to risk it by giving utterance to such views; and the stated volume of the traditional freshet, which for a single hour might be estimated at double or thrice the average hourly flow for 24 hours, was too formidable to think of passing it *through* a bank 170 ft. high—that was left for a carpenter, or something of that ilk to attempt—with what success the newspapers of the day chronicled. Nor was it feasible at any reasonable expense to build a culvert high up such a bank, and expect it to stand. There was nothing for it

but to estimate a culvert at or near the bottom, with such loose filling above it as the locality afforded; and for the height of bank required, even a single track (6 ft. gauge) would require a width of 18 or 20 ft. at grade. Such were the conditions required by a solid bank at that place.

On the other hand, a reliable contractor and bridge builder, stood ready to undertake the construction of the bridge, on an item contract amounting to $18,000,* and the bridge was decided upon. The fact that the Cascade bridge was, as it were, a show card for the engineer who devised it, has nothing to do with its merits as a solution of the difficulty with which the company was then confronted. With an exhausted exchequer, economy in first cost was then almost a necessity, and the plan pursued in the construction of the bridge safely filled the bill. Precisely the same argument was used in the case of the Starrucca viaduct, as the best method, with judicious economy, of crossing that valley, consistently with the avowed policy of the R. R. Co., previously referred to. Luckily broader principles soon prevailed, and after the foundations were completed and most of the piers had been commenced, two feet was added to the width of the bridge at grade level by flattening the batter of the pier heads, by which expedient alone, the present engineer of the Erie, Mr. BUCHHOLZ, has been enabled to lay two tracks over the viaduct where but one was originally contemplated.

But to return to the Cascade. To the rule refered to previously, as to the second track, the Cascade bridge was made an exception, and it was built to accommodate two 6-ft. gauge tracks. There were two points, however, in the construction of this bridge, which succeeding administrations disregarded. The first was that the center line was not on the true location of a double track, but on one side of it, so that when a new permanent structure should be called for, such construction could be properly carried out, leaving the oldest structure in place for such use as it might serve by a small expenditure in repairs. The second was, that while the plan of the bridge admitted of the removal of any timber without interfering with the traffic over the bridge, thus providing for natural decay, the chance of destruction by fire was reasonably provided for by the bridge being a deck bridge weather-boarded, susceptible of substantially a fire-proof covering on top, while the frame-work of the scaffolding used in its section, for which Mr. FOWLER, the contractor, is entitled to much credit, was, when removed, marked and stored under cover some distance below the site of the bridge. This framing, so carefully housed, and which an insignificant sum could have preserved, whereby the platform of the bridge could have been restored so as to safely pass trains within 12 hours, after the destruction of the bridge by fire, soon came to be regarded as a mine from whence repairers could obtain squared, seasoned timber to their hand without any questions being asked. So much for precautions against fire.

When the railway was opened engineers were no longer needed, and went their way, "to seek fields and pastures new", and another class of men came to the front.

There had been an ambitious carpenter, with a considerable opinion of himself, placed in charge of the repairs of timber structures on the road, who had the address to obtain authority for conducting, at the expense of the company, a most extensive series of experiments on timber bridges. These, on a large scale, under the auspices of the company, were constructed and tested to destruction, resulting in his taking out a patent for an "Inflexible Arch Truss Bridge." Indeed, a factory for their wholesale construction had been established for the supply of this and other roads, and to a large extent, profitably worked; and when it is considered that this carpenter at the same time had contrived to work himself into the position of General Superintendent of the New York & Erie Railroad, it will be readily understood that his patent "Inflexible Arch Truss" soon came to be regarded as a good thing to have on any road, and certainly on the N. Y. & E., where it soon replaced all other wooden bridges, and the superintending carpenter was credited with repeatedly saying, that "the Cascade bridge out of the way, he had built the longest wooden railroad bridge in the world."

The Cascade bridge, however, did not admit of being replaced by one of these "Inflexibles." There it stood, and no amount of neglect appeared conducive to a very early failure of the structure. About this time (1855) we began to hear of the danger to be apprehended, and the interruption to traffic which would follow its destruction by fire!—No special precautions, such as covering the deck with metal—or establishing a watchman at the site with water tank and hose, was recommended, so far as we could learn, but great anxiety continued to be manifested about it in the published reports of the superintendent, who proposed a change of the line, presumably up stream, and a bank and masonry culvert was hinted as the proper thing. There was no Chief Engineer to the road at that date. The superintendent had under him, it is true an officer rated as Assistant Engineer, but his duties were entirely subordinate to the Carpenter-in-Chief.

An estimate for this change of line appears in the superintendent's annual report for 1856, amounting to $103,237. The Railroad Commissioners for the State had been induced, by plausible rumors affecting the integrity of this bridge, to order its thorough examination by an engineer appointed by themselves, and Mr. JAMES LAURIE, the first president of the Am. Soc. C. E., was assigned to the duty, whose report will be found in the R. R. Commissioner's Report of the State of New York for 1856, pp. 310. Mr. LAURIE after describing the bridge and its location on a 60 ft. grade, says: "The practice has been to use sometimes *three* coupled engines in front to draw, while one or two engines pushed," and as he truly remarks, "subjecting the structure to very hard service;" but the use of lighter trains having come to be considered as more advantageous for the traffic, the present practice was for "but one engine in front, and two others pushing behind.". He accordingly experimented with the regular freight trains of Dec. 21, 1855, as they passed the bridge going eastward; and with coupled engines weighing 51.8 and 54.2 tons, and also with emigrant trains going westward: and he reported as to the entire adequacy of the bridge for the service required of it. No repairs had ever been made, none were then necessary; and "estimating the weight of the bridge as two tons per lineal foot, which he considered as in excess of the actual weight, and crossing the bridge with *two* trains of the heaviest class of engines and their tenders, he estimated the strain on the bridge as something less than 500 lbs. per sq. in., or about one half of what is considered as a safe load;" and the observed deflexion he reported as susceptible of reduction, "by more thoroughly wedging the cross braces." It seems scarcely credible, that with a carpenter at the head of affairs, and a bridge of questionable strength, it had been no one's business, up to this date, to apply the common sense precaution of keeping the braces in proper action by oaken wedges!

Mr. LAURIE closes his report by stating that while there is no question of the strength and stability of the bridge, and that it was foreign to the object of his appointment to go into other matters, he would suggest, in view of its possible injury from fire, etc., that it was not too soon to consider the subject of a more permanent crossing, and recommended two possible methods of effecting it; but one in particular, for present economy he says; "would render the bridge perfectly secure for many years to come." (See his report pp. 313). This preservation of the Cascade bridge, however, formed no part of our carpenter superintendent's plan. The bridge was doomed beyond peradventure, *if he could effect it*, and from the newspapers of the day I gather the fact, that with the exception of substituting an open bank below, for a culvert, and disregarding any expedients for the preservation of the obnoxious bridge, he endeavored to follow Mr. LAURIE'S suggestion, but the modification in the plan which his conceit had led him to adopt proved disastrous, and he was driven to the expedient of a tunnel to pass the freshet waters of the stream. The estimate of the expense prior to commencing operations, as we have seen, was $103,247; presumed to be, as usual, under, rather than over-estimated. The bank, open at bottom, instead of passing the freshet waters as was anticipated, proved to be in a short time, a *dam* without a weir; a washout was the result, interrupting the passage of freight for several days; a trestle was erected over the break, and finally a tunnel was driven in a side of the ravine, before the bank could be completed to grade. All this occupied time, and was tentative throughout, and the total expense incurred, before it could be considered as complete, I place at nearer $200,000 than $100,000. I doubt very much whether the books of the company can show the actual cost of the "improvement."

I will say that a more stupidly malicious act of vandalism never was perpetrated, than was effected by this carpenter-superintendent, when he removed under the trumped up plea of danger from fire, the only obstacle existing to his ambitious claim of having constructed the largest span railway bridge then extant; and that civil engineers could be found to second so miserable a lead, only indicates the depth attainable in some professional practice.

J. W. ADAMS.

[THIS letter from Col. JULIUS W. ADAMS, giving the early history of both the Cascade bridge and Starrucca viaduct, both of which he designed and built—and both of which were among the most creditable features of almost the most creditable monument of our early engineers, the Erie Railway will, we have no doubt, be read with general interest. In connection with the letter of MR. ALFRED F. SEARS, which appeared in our last issue, it gives both sides of a question which was much debated at the time, as it has been since. We had no idea that, in briefly animadverting on the experience in filling the gorge as a text for an article on quite a different subject matter, any questions of a personal nature would arise, but we cannot regret it, inasmuch as it has brought out such full information.

The main facts, as we now see them, are these: The Cascade bridge originally was beyond question the cheapest and most suitable structure for the place and the time. A fill 175 ft. deep at the center was no light matter to contemplate, and the fact that the substitute for it would be a structure which was and is one of the great monuments of engineering progress, was certainly no reason for not adopting it. The MCCALLUM bridges, with all the other early types, have now passed out of use, and it is highly probable that unfounded if, entirely conscientious prejudice may have hastened the condemnation of the Cascade bridge, which, had it lasted ten or fifteen years longer, would probable have been replaced by an iron span or trestle instead of a fill, as much cheaper.

The purpose to pass *all* the water of the stream through the interstices of a rock fill seems to have been precisely as we stated. A rock fill was carried up about 50 ft., then an earth fill to grade added on top and the track laid over it. If it was purposed to put in a culvert at all to carry off the only dangerous water, flood water, why in the name of common sense was a rock-borrow fill 50 ft. high put in merely to pass the trifling normal flow? Two or three years thereafter (if we are correctly informed) the bank had so choked that the track was washed away, and then only was a tunnel thought of or begun. The rock fill, however, is not now so tight as we had been given to understand. The small normal flow of the stream finds its way through so well that only "three or four times a year" does a pool 50 ft. deep form about it, and cause a discharge through the tunnel. We are informed, however, that the fill is growing perceptibly tighter every year, and as it is obvious that a few car-loads of fine material, judiciously disposed, would make it at any time impervious to water, the particular question which led to this discussion of the existing conditions is not affected thereby.—ED. ENG. NEWS.]

* True bill of materials and specifications of Mr. John Fowler, for building Cascade bridge, 1847.
327,274 B. M. timbers @ $30. Masonry 213 cu. yds @ $5. Net line, 11,879 ft. @ 10 cts. Cost dam, 38,878 ft. @ 5 cts. False work, $2,775. Painting $1,000. Total, $17,700. The bills of materials and extras, largely in excess of this bill, embraced in the *final estimate*, of date of July, 1849, amounted to $40,674, at contract prices.

ENGINEERING NEWS

AMERICAN RAILWAY JOURNAL

Published Weekly at Tribune Building, New York.

VOL. XX. Saturday, September 8 1888.

D. McN. STAUFFER. A. M. WELLINGTON.

EDITORS.

GEO. H. FROST, - - - BUSINESS MANAGER.

Subscription. – UNITED STATES AND CANADA, $5.00 *per Year; $2.50 for Six Months; $1.50 for Three Months; Single Copies, 12 cents.* FOREIGN COUNTRIES, $6.56 *per Year, or 3 cents per number additional.*

Drawings and Photographs *of all new engineering works or designs, large or small, of interest from their magnitude, novelty or originality, as well as newly adopted* **Standard Plans** *for engineering structures or details, rolling stock, etc., are always desired for early publication. Also,* **Brief Technical Notes** *of the cost or manner of executing work, tests of materials, machines or other new devices, and* **News of New Construction** *of all kinds.* **Letters** *for publication must be accompanied by the name or card of the writer.*

Drawings for publication *should preferably be in plain black and white, considerably larger than they are expected to appear, with letters and figures in pencil only, all lines clean and bold.*

Coming Technical Meetings.

Roadmasters' Association of America.—Next meeting at Washington, D. C., Sept. 11. Secy., H. W. Reid, Waycross, Ga.

Engineers' Society of Western Pennsylvania, Pittsburg, Pa.—Regular meeting, Sept. 18. Secy., S. M. Wickersham, Penn Building.

Boston Society of Civil Engineers, Boston, Mass.—Regular meeting, Sept. 19. "House Drainage". Secy., S. E. Tinkham, City Hall.

Association of North American Railroad Superintendents.—Next meeting at the Southern hotel, St. Louis, Mo., beginning Sept. 19. Secy., Waterman Stone, Providence, R. I.

American Society of Civil Engineers, New York.—Regular meeting, Sept. 19. Secy., John Bogart, 127 E. 23d St.

Engineers' Club of Kansas City, Mo.—Regular meeting, Oct. 1. "The Complete Sewerage of Kansas City." Secy., Kenneth Allen, 19 Deardorff Building.

Civil Engineers' Society of St. Paul, Minn.—Regular meeting Oct. 1. Secy., Geo. L. Wilson, City Hall.

American Institute of Mining Engineers.—Next meeting at Buffalo, N. Y.; beginning Oct. 2. Secy., R. W. Raymond, 13 Burling Slip, New York.

Civil Engineers' Club of Cleveland, O.—Regular meeting Oct 9. Report on Civil Engineering. Secy., James Ritchie, Care Library Rooms.

Engineers' Club, Philadelphia, Pa.—Regular meeting Oct. 6. Secy., Howard Murphy, 1128 Girard St.

American Society of Mechanical Engineers.—Convention and annual meeting at Scranton, Pa.; beginning Oct. 15. Secy., F. R. Hutton, 280 Broadway, New York.

American Street Railway Association. – Next meeting at Washington, D. C.; Oct. 17. Secy., W. J Richardson, Brooklyn, N. Y.

IT'S an ill wind that blows no good, and if the pending little difficulty over the fisheries question shall create just enough of a war scare (which is doubtful) to cause the country to appreciate and remedy the absurdly helpless condition of our sea-coast, by putting our chief ports at least in reasonably defensible condition, it will not be in vain. This country is blessed above all other great nations in its geographical position, which insures it against all danger of successful invasion, and as it is likewise the most peaceable of nations, and the least likely of all to engage in an aggressive war, the prevalent indifference to all preparations for either offense or defense is comprehensible; but we have not yet reached that stage in civilization when war with any power, even England, is an absolute impossibility, and when the cost of protecting our only vulnerable point, our sea-ports, is so trifling in comparison with the burdens that other nations bear, it is amazing that a fair slice from our unmanageable surplus is not by unanimous consent diverted to that end. Certainly the money would be well invested as a mere insurance against war.

To see how very large is the injury which might be inflicted by successful attacks on our Atlantic ports, the total assessed valuation of New York, Brooklyn, Jersey City and Newark verges close on $2,000,000,000; the real valuation is fully $3,000,000,000. The valuation of mere personal clothing and furniture in the whole United States is about one-fourth of the total valuation of real estate. The valuation of merchandize, grain, shipping, etc., etc., always in stock in New York, is alone enormous and there is probably in all fully $1,000,000,000 of portable property of all kinds, apart from real estate and from gold, silver, currency and securities payable to bearer, which rise to several hundred millions more.

On the other hand, the total estimated wealth of Canada, real, personal and all included, is only $3,250,000,000 or hardly two-thirds of half the valuation of New York and its surrounding cities alone. One British, Italian or Chilian iron-clad, therefore, after it had once entered the bay, or even when off Coney Island, could cause us more loss than we should gain if all Canada were not only annexed but confiscated.

We do no assert nor believe that it would be such entirely clean sailing as is commonly assumed for one or a dozen iron-clads to walk into our ports unmolested. We have kept up our torpedo schools, and what not, for the last twenty years to little purpose, if we should not be able to make it unpleasant for some of an attacking fleet, if not for all, by means which are not necessarily proclaimed upon the house tops; but the chances of successful defence are strongly against us, and the disgraceful feature is that all such danger could be averted by a very moderate expenditure which would be almost worth its cost directly by the stimulus it would give to certain forms of iron and steel manufacture. Congress showed a disposition to do something in this line even before the late retaliation flurry, and although it will not be likely to do much more on that account it will not be likely to do less.

ELSEWHERE in this issue will be found a statement of the "Railway Progress in America" in 1831, showing a total of 110 miles in operation at that date. A comparison of these figures with the round 150,000 miles of operated roads reported in the last Poor's Manual will enable us to form some conception of the progress made in this direction in the intervening half-century. But the fact that within about three years of the first practical test of locomotive traction, our people had over 1,000 miles of railway in operation and under construction, proves that Americans very early appreciated the advantages of this new system in the development of their vast territory. That they fully foresaw the phenomenal rate of its growth and the untold benefits to arise from it is hardly to be expected. The scolding that the editor of the Boston magazine quoted inflicts upon the management of the Baltimore & Ohio R. R., doubtless had for its incentive the fear that this extravagance would discourage and delay other badly needed improvements; and the advice given was sound enough for the day and the main purpose then in view; *i. e.*, the connection of trade centers and the rapid extension of railways into rich but then commercially inaccessible territory.

THE New York *Sun* justly calls attention to the fact that the past month of August has been signalized by an unusual number of disasters involving loss of life, as well as by meteorological eccentricities, and publishes a chronological list—evidently compiled somewhat hap-hazard by a reporter—which it has seemed to us worth while to reclassify under causes. Of course it is only a chance collection, and a very partial one also, in that it includes few or none of the multitudinous individual accidents, murders and what not, which aggregate an enormous number each month, but do not rise to the dignity of what are called calamities. But as nearly all railway accidents and failures of engineering structures belong to the latter category, a list of the wholesale disasters only tends to unduly magnify the proportion of them rather than otherwise.

This being so, the small part which railway disasters play in the aggregate loss of life, as shown in the following abstract, is certainly a striking one, and except for the one instance of a reservoir which burst in Chili, causing a loss of 200 lives, the same is true of all kinds of accidents due to bad design or construction, engineering or architectural. Yet the general public has a far keener appreciation of its dangers from these causes than from all others put together. The list summarizes as follows:

Cause of Disaster.	*Total killed.*
Railway disasters	10
Lightning	27
Marine disasters	188
Storms	99
Inundations	825
Volcanoes	460
Earthquakes (none recorded).	
Reservoir burst	200
Other bad construction	5
Pestilence	3,090
Fires	62
Explosions	21
Massacres and riots	903
Total violent deaths recorded	5,890

IN detail the list of disasters was as follows:

Railway Disasters.

	Killed	Injured
Aug. 2.—Smashup at Gaylord, Mich	3	15
Aug. 8.—Collision near London	6	
Aug. 9.—Near Morgantown, Ill		14
Aug. 13.—St. Louis express on the Erie wrecked	1	
Aug. 14.—Wreck on the Erie near Port Jervis		33
Aug. 17.—Collision on Illinois Central		7
Total railway disasters	10	69

Lightning.

	Killed.
Aug. 3.—Illinois and Minnesota	4
Aug. 5.—New York and vicinity	3
Aug. 13.—Ohio and West Virginia	6
Aug. 24.—At a baptism at Carter's Wharf, Va.	3
Aug. 5.—New York	5
Aug. 10.—Hudson River Valley	2
Aug. 10.—Virginia	1
Aug. 11.—Anderson, Ind	3
Total lightning	27

Marine Disasters.

	Killed.
Aug. 10.—Yacht capsized in Delaware Bay, near Pennsgrove; 5 women imprisoned in the cabin and drowned	5
Aug. 12.—Steamer *Bay Ridge* burned	1
Aug. 13.—Rowboat swamped in East River. Canoe upset at Bar Harbor	4
Aug. 17.—Steamer *Geiser* run down by the *Thingvalla*	118
Aug. 23.—Steamer *City of Chester* sunk in San Francisco Harbor	31
Aug. 29.—Steamer *Bratsberg* wrecked on the St. Lawrence; 15 lives lost. Barge *Jackson* lost at sea with 3 persons	18
Aug. 29.—Steamer *Snaresbrook* sunk near Tarifa	11
Total marine disasters	188

Storms.

	Killed.
Aug. 14.—Storm in Indiana Co., Pa	several
Aug. 18.—Severe storms in Canada and Massachusetts; 4 persons killed at Valley Field, Quebec, and 2 at Greenfield, Mass	6
Aug. 21.—Great storm in the southwest; 18 persons killed and 1,200 made homeless in Louisiana	18
Storm at Korenburg, Austria; great damage done.	15
Aug. 22.—Cyclone along the middle Atlantic coast; 11 persons killed at Still Pond, Md., many lives lost elsewhere and great damage done from Maryland to Maine	20
Sept 1.—Water spout at Hot Springs	13
Sept. 1.—Storm at Cape of Good Hope; many lives and vessels lost	30
Sept. 1.—Cloud burst at Beaver Creek, Col.	7
Total known lives lost in storms	99

Inundations.

	Killed.
Aug. 4.—Russia	25
Aug. 25.—Teng-Teona, China	800
Total floods	825

Volcanoes.

	Killed.
Aug. 3.—Volcanic eruption in Japan; 400 persons in one village and many others elsewhere killed, say	450
Aug. 7.—Volcanic eruption at Vulcano, Italy	10
Total volcanoes	460

Bad Construction.

	Killed.
Aug. 3.—Fall of roof of famous cathedral in Seville	2
Aug. 12.—Reservoir burst at Valparaiso, Chili	300
Aug. 21.—Fall of an arch in Hoboken	2
Aug. 28.—Patform fell at public meeting in New York; several injured	1
Total bad construction	305

Pestilence, Etc.

	Deaths.
Aug. 2.—Typhoid fever epidemic in Bristol, R. I.	30
Aug. 3.—Cholera in Amoy (in 60 days)	3,000
Aug. 31.—Outbreak of typhoid fever at Caldwell, O.	25
Aug. 10 to Sept. 1.—Yellow fever in Florida; 32 deaths in Jacksonville and many elsewhere	45
Total pestilence	3,000

Fires.

	Killed.
Aug. 4.—Bowery, N. Y.	21
Aug. 9.—Third Ave., N. Y.	4
Aug. 12.—Chattanooga, Tenn	4
Aug. 24.—1,000 houses burned and many lives lost at Orenburg, Russia, about	30
Aug. 28.—Destructive forest fires, burning also Nadeau, in upper Michigan	3
Total fires	62

Explosions.

	Killed.
Aug. 5.—Powder at Birmingham, Conn	2
Aug. 24.—Boiler explosion at Neenah, Wis.	14
Aug. 30.—Explosion of gun at Hemlock Hollow, N. Y	3
Aug. 31.—Dynamite near Albany, N. Y	2
Total explosions	21

Massacres and Riots.

	Killed.
Aug. 9.—Riot in France	7
Aug. 14.—Italian troops by Abyssinians	350
Aug. 16.—Famine stricken soldiers in Epirus pillage Metzovo	30
Aug. 18.—Prince Umley, of Morocco, and 200 soldiers massacred	200
Aug. 29.—Muley Hassan putting whole villages to the sword in Morocco, in revenge for his son's death, say	200
Aug. 30.—Fight between dervishes and soldiers in Egypt	116
Total massacres and riots	903

Were all murders and individual accidents added to this list the total would certainly be swelled a thousand or two more and probably 40 or 50 more deaths added both to the "railway" and "bad construction" list, for the average number of railway deaths from train accidents alone in this country is nearly 100 per month, but the contrast would still remain substantially what it appears above.

The Railway Record of 1887.

The main results of the operation of all the railways of this country is something which interests not the engineer and railroad man alone but everyone dependent upon any interest for his livelihood, for it is by far the best single evidence of the general tendency of events in the business world. For this reason the appearance of the annual edition of "Poor's Manual," in which alone can be found a general summary of the facts for each year, is always looked for with interest, and we give up a good part of our space this week to a full reproduction of its more significant features. It is surprising that so important a work as the collection of these statistics—perhaps the most important of all the commercial statistics which are annually compiled—should be left entirely to private enterprise, but the work is well done on the whole, and although in some respects the records would be more complete if officially collected, yet in others they would probably be inferior, and on the whole the public has no reason to regret that the work is done by whom it is.

The grand total (well so called) of railways in the United States had, at the beginning of the year, according to Poor, reached within a few miles of the even total of 150,000 miles (149,913), the gross increase for the year being given as 13,081 miles, and the net increase, as compared with the totals given for last year being 11,927 miles. Our own figures for the total, which are quoted in the Manual in connection with a reproduction of our general map of construction for 1887, published June 16, 1888, were 12,668 miles, and we apprehend that this is not far from the true aggregate. Some discrepancies in this aggregate are unavoidable owing to the discontinuance of some mileage, and the improper inclusion of logging and other temporary roads which are for a time regularly operated, as well as from slight errors as to date of track-laying.

But we may here note a discouraging evidence of the difficulty of securing accuracy in such a mass of figures, which certainly indicates also that not sufficient care is exerted in that direction. In the column of "annual increase of mileage", on p. xxiv, there are three errors in eight lines. The increase of 6,876 for 1880 should be 6,886; 3,825 for 1884 should be 3,925, and 9,000 for 1886 should be 8,999. In addition to this, the annual increase of mileage for 1887, is apparently by inadvertence omitted. There is also a serious and apparently unnecessary discrepancy between the annual increases for 1885-6-7 given in the first and second table on page xxiv, which compare as follows.

	1885	1886	1887	Total
First table	3,608	8,999	11,927	24,534
Second table	3,131	8,400	13,081	24,612
Difference	+477	+599	−1,154	−78

It is evident that there is no necessity for having such discrepancies as these between tables giving the same facts on the same page, even in a single edition, yet these three errors were all of them made in last year's edition, and are repeated in this without correction.

Passing from these details, however, to the substance of the report, we have no doubt that it is sufficiently exact to give a correct idea of the general tendency and condition of railway matters, and the showing is certainly most gratifying: 1884 and 1885 were years of depression, the earnings of about $770,000,000 in each year being almost indentical with those of 1882, when the mileage was far smaller, and some $52,000,000 less than in 1883, also with smaller mileage; but 1886 showed a sharp recovery to $830,000,000, and now, 1887 shows the enormous jump of $110,000,000 to $940,000,000. The earnings per mile of road also make an exceedingly good showing, as shown in Table III. and IV., on another page. They are some $300 per mile larger than last year, or $6,861 per mile, and the largest since 1883, when they reached $7,461 per mile. The apparent fall since then, however, is due only to the large amount of new construction in new country, as we may see by comparing the earnings per mile by sections, for a few years past. We omit the tabular figures, but they show in the older sections of the country a handsome increase to the largest earnings ever touched, on the whole, it being only in the newer sections, which have a large amount of new mileage, that there is a decrease.

The proportion of passenger earnings still remains nearly constant, as it has for many years, at 26 per cent., freight earnings being this year slightly over the usual average of 67 per cent. The fall in rates, however, which has gone on for so many years without a check, does not appear this year, the average freight rate being 1.063 against 1 042 cts. last year, and the average passenger rate showing the still larger recovery of 2.276 cts. from 2.181. One reason for this, and perhaps the chief one, is the decrease in average length of haul, the figures for which are well worth studying (Table III.) as indicating that the development of the country is reducing the length of haul on both passenger and freight. The present figures of 24.68 miles per passenger and 108.79 miles for freight show on the whole a decrease of 3 or 4 per cent. in this respect within the past three years. As the country settles up this tendency must inevitably continue, and it is a sure sign of healthy development.

It is impossible to say exactly what are the corresponding figures for the English railways, because their railway accounts, alone among those of civilized nations, take no cognizance of length of haul, but only of the total number of passenger or tons transported. According to the estimate made in Mr. DORSEY'S elaborate paper on "English and American Railroads Compared," which we believe to be substantially correct, the average haul in England is only 7.2 miles per passenger and 35 miles per ton of freight. The extent of the error which results from comparing English and American traffic on the basis of number of tons only, as is often done, is apparent from these figures.

A singular and unfortunate omission from the tables of the *Manual* is some record of average train-load. These figures ought to have a certain interest even to stock-brokers, and among railway officers and engineers they are among the most significant of all. Computing them approximately by the slide-rule, however, it is apparent that the tendency to increase of train-load which accounts for so large a part of the decrease in rates still continues unchecked, the average freight train load for the whole United States being.

	1887	1886	1885	1884	1883	1882	1880
Tons	152	151	143	134	126	129	129

Where the enormous progress here shown has been made may be seen by comparing the similar figures for sections, which we compute as above for 1887, and take from p. 97 and 115 of "The Economic Theory of the Location of Railways" for the other years:

Average freight train load.

Section.	1887	1885	Incr.	1880
New England	109	102	7	90.6
Middle	184	179	5	163.6
North Central	162	139	23	122.8
South Atlantic	117	93⅓	23⅔	85.5
Gulf and Miss. V.	131	125	6	
So. Western	117	118	(—1)	61.3
No. Western	153	148	5	95.5
Pacific	179	115	64	
Total U. S.	152	143	9	129

[The figures for 1880 were computed from the U. S. Census Statistics, which follows a different grouping of States, so that they cannot be exactly compared with 1885 and 1887, except for the New England States.]

Here it is very apparent that the greatest progress is being made in the Southern and North-central States (the great increase for the Pacific being probably due to some error); but every section shows unmistakably the same tendency, except the South-Western group, which includes Kansas and other States of active construction, when the multitude of new roads obscures the tendency. It is highly desirable that these figures of train-loads should be made a feature of the *Manual* hereafter. In passenger train-load there has been no significant change, it remaining at about 45 per train.

The returns paid to capital show a slight improvement this year over last (3.40 against 3.26 per cent.) but are still below the 3.5 to 3.7 per cent. paid in 1882 4. The Southern States show the poorest results (2.18 per cent.) and bring down the average greatly, very little of the stock of Southern roads bringing in any return whatever. This is well shown (for 1886, not 1887) in Table VII. elsewhere, abbreviated from the more detailed statement of the volume. The bonds make a much better showing, as is to be expected, about 90 per cent. of them earning interest in the Northern States and about 75 per cent. of them in the Southern. But there are great differences in this respect in the different States. The averages by sections are:

Group of States	Average Interest		Per cent. productive bonds	
	1882	1886	1882	1886
New England	5.18	4.80	88.18	91.28
Middle	5.01	5.16	90.73	94.05
North Central	4.47	4.38	86.53	89.93
South Atlantic	3.33	3.85	72.52	78.08
Gulf and Miss. V.	4.51	3.74	91.94	85.69
So. Western	4.84	5.16	78.00	79.74
No. Western	5.45	5.10	92.78	96.83
Pacific	4.58	3.77	89.37	87.29
Total U. S.	4.71	4.52	86.84	89.12

Here we may see that although the average rate of interest is falling, due to the cheapening of capital, yet that the percentage of good bonds had materially increased even in 1886. Last year, it is quite certain, it was still larger, and this year it will be larger yet.

It is a great pity that these and a large number of other tabular records given in the volume cannot be made out for the current year of the volume instead of for the year previous. It necessitates of course waiting to compute them until all the statistics have been compiled, but by the aid of a Thacher computing instrument, which is admirably adapted for such work, all the unusually full calculations given in this year's introduction could be made complete within a week, and probably with still less delay. As it is, many of the tables lose their interest from being nearly two years old at time of publication, and a still worse cause destroys the value as well as the interest of the numerous records based on population, that population has changed greatly and irregularly since the last census of 1880 was compiled. For example, the population per mile of road is given for each State separately for 1880, 1883 and 1886, with such interesting results as that the population per mile of roads in Dakota has decreased from 110 people in 1880 to 36½ persons in 1886, and from 293 to 163 in Kansas. All such divisions of 1886-7 statistics by 1880 populations are necessarily deceptive, and for that reason we have not reproduced any of them. It would have been far better to have made as careful estimates as possible of the actual population of 1886, which can be done with considerable accuracy for each State separately. Were an intermediate census, at least a mere count of heads, taken every five years, these statistics would have great interest, but as it is, they are of little worth even for comparison of State with State.

Area, however, is something which does not change, and the column showing for each State the square miles per mile of road in 1886 is certainly very interesting reading. The average for the whole United States being 21.19 (20 in 1887, against 6 in the United Kingdom and 7 in France, we may note) Massachusetts and New Jersey show only 4 sq. miles per mile of road (about that of Belgium). Excluding northern Maine, which brings the New England average down, the average of the whole New England, Middle and North-Central groups is under 7. The south averages about 22, Kansas the remarkable average of 13.41 (not over 7 for the mere fertile portions only, or the average of Iowa) and even the Pacific coast and territories only average 77 sq. miles per mile of road which indicates how fast the whole country is filling up.

It is somewhat amusing to remember in this connection that in 1881 Mr. EDWARD ATKINSON, of Massachusetts, made an estimate which was much criticised at the time as excessive, showing that by 1900 the total mileage would be 209,225, which required that even then Florida, Dakota and 7 territories would only average one mile per 64 sq. miles. Florida already averages only 27 sq. miles per mile, Dakota averages only 34 and the group as a whole only about 80. We have only to build about 59,000 miles in 13 years, or about 4,500 miles per year to reach the estimated aggregate of 1900. The six years which have expired since 1881 has averaged 7,795 miles per year.

The two mileage tables by States given on pp. iv. and xxv., of the introduction do not agree at all, and for Dakota we have the surprising contrast of 521.60 against 4,323.50 miles. The difference is chiefly a legitimate one, due to the necessity of including in one place only the mileage, reporting separately records of steel rails, rolling stock, etc., while in the other only the exact mileage is considered.

Another very interesting table is the ton-mileage of freight per sq. mile of territory and per mile of road. For the various groups of States, these totals are as follows:

Ton-mileage of freight, 1886.

Group of States.	Per sq. m.	Per mile ry.
New England	30 097	310.688
Middle	156,856	1,018,296
North Central	81,093	468,865
So. Atlantic	7,935	201,624
Gulf and Miss. V.	8,647	242.236
South Western	5,661	213.046
North Western	7,082	236,047
Pacific	1,375	155.740
U. S.	17 523	421,923

A table containing still more interesting material is one on page xviii. showing by States and sections the comparative ton-mileage and passenger mileage for 1886 and for the average of the five years 1882-6. We have computed from these data the percentage of increase for each section, as follows. It is to be remembered that 1887 has shown still more decided tendencies in the same direction.

Per cent. of increase in ton-mileage and passenger mileage, 1886 over the five years 1882-6.

	Ton-mileage.	Pass.-mileage.
New England	9.4	10.0
Middle	10.5	(—11.4)
No. Central	13.0	32.2
So. Atlantic	37.6	31.3
Gulf & Miss V.	32.1	(—1.7)
So. Western	145.3	24.4
No. Western	22.8	18.2
Pacific	(—1.1)	5.1
U. S.	21.6	11.7

Some of the irregularities of this table are probably due to clerical defects, but through it all the great progress which the Southern States have been making lately is clearly conspicuous. That the same tendency continued strong through 1887 may be shown by computing the following:

Increase per cent. in gross earnings, 1887 over 1886.

	Per cent.
New England group	5.9
Middle "	8.5
Southern "	14.1
Western "	14.1
Pacific "	38.2
U. S.	13.3

The grouping here is different from that above, but the main facts are clear, and are pointed out in another way with equal clearness in the extract from the introduction which we make elsewhere.

A small table given in the part of the introduction, which we reprint, points out very strikingly the enormous fraction of the total traffic of the United States handled by the three great trunk lines, but if we eliminate the branches from this traffic and show the proportion handled by the three *main lines only*, the facts become still more striking. It is difficult to do this with exactitude, but in a general way the earnings per mile of the branches of these trunk lines are hardly more than one-tenth of the main lines, and the earnings per mile of the West Shore and N. Y. P. &O. considerably less than one-half the rate of the main lines only of the New York Central and the Erie. Taking them at one-half, however, we find that the 1218 miles of *main line only* (New York to Buffalo by the N. Y. C. and the Erie; Philadelphia to Pittsburg by the Pennsylvania) do as nearly as may be *two-thirds* of the whole so-called trunk line traffic handled over 4,506 miles of main lines and branches, the other 3,288 miles doing only the remaining third, and we have the following comparison:

	Miles	Per cent. of total U. S. Mileage	tonnage	earnings.
Main line and b'ch's	4,649	3.3	11.8	10.1
Main lines only	1,218	0.8	7.9	6.7

Owing to the fact that every one of our important trunk lines has a vast amount of subsidiary and tributary mileage which earns comparatively little, few people av e an idea how small a fraction of our railway system does half its business. Were it possible to take out the earnings of parts of systems only for this purpose there can be no doubt it would be found that 9 or 10 per cent. of the mileage does over half the business, the remaining 90 per cent. having to eke out a subsistence on the other half.

We have left no space to enter further into facts covered by this interesting annual report, which we have by no means exhausted. Some of them we shall refer to at a later date.

PERSONAL.

Superintendent MCGINNIS of the South Chicago plant of the North Chicago Rolling Mill, has tendered his resignation.

E. T. SMITH, formerly Master of Trains on the Georgia Pacific, has been appointed Superintendent of the western division of that road.

J. G. METCALFE, Superintendent of the St. Louis and Henderson division of the Louisville & Nashville R. R., has been appointed Superintendent of the South & North Division.

W. H. FISHER, Vice-President and Superintendent of the St. Paul & Duluth R. R., has resigned. He will be succeeded by E. L. DUDLEY, Receiver of the Central Iowa R. R.

Dr. H. MOORE, of Irvington, Ind., has been appointed Receiver of the Indiana Midland Ry., on a petition of the Island Coal Co. and Scranton Steel Co., to which the road is indebted $40,000. Dr. MOORE has furnished bonds for $10,000 and taken charge of the road.

JAMES HILTON, Superintendent of the Smythe Machine Works, Manchester, N. H., was killed recently by a boiler falling on him.

C. H. BEATON, of New Britain, Conn., has been elected Chairman of the Water Board of that place.

J. C. MOORHEAD, who has been appointed Superintendent of the Western division of the New York, Pennsylvania & Ohio, to succeed S. F. RANDALL, who resigned, will have his headquarters at Galion, O.

Col. GEORGE L. PERKINS, for 50 years Treasurer of the Norwich & Worcester R. R. Co., died at Groton, Conn., Sept. 5. He was 100 years and one month old.

F. L. PITMAN has been appointed Chief Engineer of the Atlantic & Danville R. R., vice GEO. S. BRUCE, resigned, to engage in contracting under the firm name of Harper, Bruce & Co. V. O. CASSELL has been appointed Assistant Engineer, vice PITMAN promoted.

COAL, IRON AND STEEL IN FRANCE.—According to a report lately made to the French Department of Public Works, there were in 1886, 297 coal mines in operation in France with an output of 19,910,000 tons. The total production of coal in 1887 was estimated at 21,400,000 tons. The aggregate consumption of coal in France was 29,619,000 tons in 1886, as compared with 32,429,000 tons in 1883. The production of iron and steel was 3,570,000 tons in 1883, and 2,712,000 tons in 1886. The aggregate of the latter year comprised 767,000 tons of wrought iron, 1,517,000 tons of pig-iron and 428,000 tons of steel. The suspension of railway construction caused a drop of 101,000 tons in the steel rail production between 1885 and 1886. According to this same report the total production for the world in the year 1886 was 407,000,000 tons of coal and 20,500,000 tons of pig-iron.

ENGLISH papers report that the $40,000,000 capital is almost secured for cutting a canal across the Isthmus of Perekop from the Black Sea to the sea of AZOV. The canal will be 70 miles long, 65 ft. wide and 12 ft. deep, and will save 434 to 295 nautical miles in distance.

United States Railways in 1887.

Advance sheets of the introduction to "Poor's Manual" for 1888 give unusually full details of the general results of last year's railway operations, which we have discussed more fully in another column. The showing is a very gratifying one; in fact amazing in its evidence of what appears to be rapid yet healthy growth. We abstract the following from the tables, regretting that it is impossible to give space to the whole of it, which constitutes a very valuable record.

TABLE I.—GENERAL EXHIBIT FOR FISCAL YEAR, 1887.

	Miles.
Length of track laid up to December 31, 1887	149,913
Of which were completed up to the close of the fiscal years of the respective companies	147,999
Completed since the close of their fiscal years	1,914
Increase of mileage in the calendar year 1887 (9.6 p. c.)	13,081
Increase of mileage in the fiscal year 1887 (9.7 p. c.)	14,392

LIABILITIES AND ASSETS OF THE COMPANIES OWNING THE ABOVE 147,998.60 MILES OF LINE.

Liabilities.

Capital Stock	$4,191,562,029
Funded Debt	4,186,943,116
Unfunded Debt	294,682,071
Current Debt	223,243,998
Total Liabilities	$8,896,431,214

Assets.

Cost R. R. and Equipment	$7,799,471,835
Real Estate, Stocks, Bonds and other Investments	984,975,945
Cash, Bills Receivable, Current Accounts, etc., etc	415,506,735
Total Assets	$9,199,954,515
Excess of Assets over Liabilities	306,523,301
Excess of Assets in Various States as per Table, p. iv	$441,410,306
Excess of Liabilities in Various States, as per table, p. iv	137,887,005
	$303,523,301

	Miles.
Total mileage of railroads completed at close fiscal year	147,998.60
Of which full statistics of operations were received from	136,986.49
Mileage of roads not reporting earnings, etc., consisting chiefly of new roads not yet brought into full operation	*11,012.11
Miles operated	136,986.49

Passenger Train Mileage	238,755,920
Freight Train Mileage	394,191,107
Mixed Train Mileage	11,031,869
Total Train Mileage	643,978,896
Passengers Carried	428,225,513
Passengers—Mileage	10,570,306,710
Tones Moved	552,074,752
Tons One Mile	60,061,069,996
EARNINGS.—Passengers	$240,542,876
Freight	636,066,223
Other	54,176,055
Total	$931,385,154
Operating Expenses	600,249,478
Net Earnings	$331,135,676
Other Receipts, including rentals received by lessor companies	+83,164,355
Total Available Revenue	$414,300,031
Payments from Available Revenue:	
Interest on Bonds	$195,418,710
Other Interest	6,500,200
Dividends	90,013,458
Rental	+42,042,277
Miscellaneous	41,168,903
Total	$375,233,548
Balance—Excess of Available Revenue over Actual Payments therefrom for the year	$39,066,483

The *Manual* comments on the statistics as follows:

The summarized tabulations of the returns of the railroad system of the country given in the preceding statements indicate a more prosperous condition of those great enterprises than was anticipated. The earnings of the year as compared with those of preceding years, make the following showing:

	1887	1886	1885
Gross Earnings	$940,150,702	$829,940,836	$772,568,833
Net Earnings	334,989,119	300,603,564	269,496,931
	1884	1883	1882
Gross Earnings	$770,684,908	$823,772,924	$770,209,899
Net Earnings	268,064,496	293,367,285	280,316,606

These figures clearly establish the fact that the period of depression in the industries of the country, extending through the years 1884 and 1885, and has been passed, and that the country is about to enter upon an era of prosperity, which can be checked only by some extraordinary and unlooked for industrial or political convulsion. So closely allied to all the industries of the country are the railroads that no other interest responds so quickly to adverse or prosperous conditions of general commercial enterprises. In this respect the railroad system may be regarded as the barometer of the entire industrial system. Thus in the reaction which followed the period of inflation, beginning in 1880 and culminating in 1883, the railroad interest was quick to show its effects.

An examination of the results for the past four years shows some interesting facts. The increase in gross and net earnings and mileage for 1887 over those for 1886 and 1884 is shown in the following Table A.

The statements show the sections of the country which are making the greatest progress in the development of their railway systems, and bear out all known facts with reference to the States which they include. For example, New England shows an increase in its mileage in the four years, of a trifle less than 9 per cent. In gross earnings and net, the percentages being respectively 13 and 17. These figures exhibit a normal development in that section; as that system, unlike that of the middle group, reflects only to a slight extent any extraordinary increase in the earnings of the western railroads. The relatively large increase in net as compared with gross earnings is a gratifying assurance of progress in the science of railroad management. The increase of the cost of working the New England roads in 1887 over 1886 being, 71 per cent. in 1887 as against 68 per cent. in 1886, is explained by the increased cost of materials and labor in the latter year.

The middle group of States, comprising the six States, New York, New Jersey, Pennsylvania, Delaware, Maryland and West Virginia, and having within its borders the great eastern trunk lines, viz.: the New York Central, the Erie, the Pennsylvania, and the Baltimore and Ohio, as well as all the great coal carrying roads, shows, in comparison to the extent of its territory and of its railroad mileage, the most marked gain.

A striking feature in the results of the operation of the railroads of the country for the past two years is the increase, shown in the following table B, of the tonnage-traffic and earnings of the three great trunk lines—the New York Central, including the West Shore; the Erie, including the New York, Pennsylvania and Ohio, and the Pennsylvania, Pennsylvania Division.

The mileage of the above lines in 1886 equalled 3.6 per cent. of the total mileage operated in the United States

TABLE II.—*Showing by Groups of States the length of lines owned, share capital, funded and other debts, length of line operated, gross and net earnings, and interest and dividends paid, by all the railroad companies of the United State for their respective fiscal years of* 1879, 1880, 1881, 1882, 1883, 1884, [*We omit all except the totals for the years* 1880 to 1885 *inclusive.* Ed.] 1885, 1886, *and* 1887:

GROUPS.	L'gth of Line Own'd	Capital Stock.	Funded Debt	Other Debt.	L'gth of Line Operated.	Gross Traffic Earnings.	Net Traffic Earnings.	Interest Paid.	Dividends Paid.
1879	*M.*	$	$	$	*M.*	$	$	$	$
New Eng. Group.	5,910	186,869,222	127,026,763	16,260,956	5,688	40,767,408	14,883,957	5,492,690	7,226,205
Middle Group	14,942	708,908,209	737,251,285	42,862,368	14,479	181,614,614	74,101,816	30,252,884	24,365,164
Southern Group.	12,978	204,600,039	248,061,428	18,771,003	12,526	40,638,117	14,671,422	5,894,446	2,131,770
Western Group.	46,102	1,146,898,767	1,047,561,016	68,427,206	42,600	298,646,031	101,234,424	54,495,170	25,765,962
Pacific Group	4,461	148,340,866	159,588,680	11,520,619	3,716	23,954,407	12,153,380	7,102,325	2,212,369
1879—Totals	84,393	2,395,647,293	2,319,489,172	156,881,052	79,009	525,620,577	216,544,999	112,237,515	61,681,470
1880—Totals	92,147	2,708,673,375	2,530,874,943	162,489,939	82,146	613,733,610	255,557,555	107,866,328	77,115,371
1881—Totals	103,530	3,177,375,179	2,878,423,606	222,766,267	92,971	701,780,982	272,406,787	128,587,302	93,344,100
1882—Totals	114,461	3,511,035,824	3,235,543,323	270,170,962	104,971	770,200,899	280,316,606	154,295,380	102,031,434
1883—Totals	120,552	3,708,060,583	3,500,879,914	268,925,285	110,414	823,772,924	293,367,285	173,139,064	102,052,548
1884—Totals	125,152	3,762,616,686	3,660,115,772	244,666,566	115,672	770,684,908	268,064,496	176,694,302	93,244,835
1885—Totals	127,729	3,817,697,832	3,765,727,066	259,108,281	123,330	772,568,833	269,493,931	187,426,035	77,672,105
1886									
New Eng. Group.	6,435	202,673,477	143,792,350	14,128,189	6,430	62,653,718	19,880,203	7,202,261	9,483,360
Middle Group	19,201	1,064,895,370	1,030,068,287	104,388,877	18,307	243,893,930	91,042,454	63,890,371	29,310,122
Southern Group.	21,376	467,097,903	489,778,278	18,252,412	18,452	74,893,959	24,630,360	19,587,706	2,798,712
Western Group.	78,948	1,998,696,761	1,993,681,315	133,538,189	75,655	411,733,513	149,035,711	90,252,836	38,122,204
Pacific Group	7,642	266,144,997	219,646,100	10,386,156	6,339	36,855,916	16,024,836	8,283,030	1,939,740
1886—Totals	133,606	3,999,508,508	3,882,966,330	280,673,814	125,185	829,940,836	300,603,564	189,036,304	81,654,138
1887									
New Eng. Group.	6,684	225,927,174	139,905,746	13,801,335	6,985	66,324,051	19,266,191	6,646,960	10,199,407
Middle Group	19,430	1,114,038,185	1,093,700,507	99,815,601	19,529	364,700,889	98,913,914	62,425,543	30,607,260
Southern Group.	23,342	488,617,577	550,931,218	19,042,391	19,751	87,137,963	28,714,902	21,215,709	2,393,132
Western Group.	90,070	2,105,031,202	2,185,049,350	155,972,029	82,367	469,834,779	167,462,078	99,718,848	46,519,860
Pacific Group	8,473	257,947,801	227,856,295	6,050,715	8,405	52,153,020	20,632,034	13,783,292	1,853,850
1887—Totals	147,999	4,191,562,029	4,186,943,116	294,682,071	137,028	940,150,702	334,989,119	203,790,352	91,573,458

NOTE.—The groups in 1886 and 1887 above, are arranged uniform with the years preceding, the Southern Group taking in all States south of the Ohio river and east of the Mississippi, except West Virginia, which goes with the Middle Group; and the Western Group covering all States between the Mississippi and the Rocky Mountains. The arrangement by States into groups as adopted for this and succeeding numbers of the MANUAL will be found elsewhere. In above table operations of elevated railroads are included.

TABLE A.

	INCREASE 1887 OVER 1886.					INCREASE 1887 OVER 1884.				
	Mileage Worked.	Gross Earnings.	Net Earn'gs.	Gross Earn'gs per Mile.	Net Earn'gs per Mile.	Mileage Worked.	Gross Earnings.	Net Earn'gs.	Gross Earn'gs per Mile.	Net Earn'gs per Mile.
	Miles.	$	$	$	$	Miles.	$	$	$	$
New England	555	3,670,333	*d.* 614,012	*dec.* 249	*dec.* 333	578	7,765,138	2,752,377	356	184
Middle States	1,213	20,837,159	7,871,460	240	94	1,673	40,955,543	21,634,562	1,023	737
The South	1,299	12,304,004	4,094,542	357	119	1,959	15,276,168	4,663,379	396	109
The West	6,712	58,101,266	18,426,367	262	64	14,939	87,963,503	31,043,707	40	10
The Pacific States	2,066	15,297,104	4,607,108	391	*dec.* 74	2,307	17,535,442	6,830,508	528	191
Total	11,843	110,209,866	34,385,555	291	68	21,356	169,465,794	66,924,623	198	126

TABLE B.

ROADS.	Miles operated.		Tons of freight moved.		Increase of tons moved.	Gross Earnings.		Increase of Earnings.
	1885	1886	1885	1886		1885	1886	
						$	$	$
New York Central	953	1,329	10,802,957	12,718,101	1,916,144	24,429,441	30,506,361	6,076,920
Erie	1,601	1,609	14,959,970	18,668,239	3,708,269	20,555,615	24,471,601	3,915,986
Pennsylvania	1,518	1,568	24,047,028	26,420,948	2,377,922	27,667,406	31,132,287	3,464,881
	4,072	4,506	49,809,955	57,807,288	8,002,335	72,652,462	86,110,249	13,457,787

ROADS.	Miles operated.		Tons of freight moved.		Increase of tons moved.	Gross Earnings.		Increase of Earnings.
	1886	1887	1886	1887		1886	1887	
						$	$	$
New York Central	1,329	1,447	12,718,101	14,626,954	1,908,853	30,506,361	35,297 055	4,790,694
Erie	1,609	1,610	18,668,239	19,865,749	1,197,510	22,500,048	24,210,357	1,710,309
Pennsylvania	1,568	1,592	26,420,948	30,847,635	4,426,687	31,132,287	35,305,729	4,173,442
	4,506	4,649	57,807,288	65,340,338	7,533,050	84,138,696	94,813,141	10,674,445

*In 1887 the greater portion of the new mileage was built in the last six months of the year, and consequently had not been brought into operation until the year 1888.

†In all cases where the operation of leased railroads are separately reported the lessor's income accounts have been omitted, a duplication of amounts under these heads being thereby avoided.

TABLE III.—SHOWING THE AVERAGES PER MILE OF STOCK, BONDS, COST AND EARNINGS, PERCENTAGE OF EXPENSES TO EARNINGS, EARNINGS PER PASSENGER TRAIN MILE AND PER FREIGHT TRAIN MILE, PER PASSENGER MILE, AND PER TONNAGE MILE, ETC., FOR 1882, 1883, 1884, 1885, 1886, AND 1887.

	1887	1886	1885	1884	1883	1882
Capital Stock per mile of completed road	$ 24,321	$ 29,935	$ 29,867	$ 30 064	$ 30,759	$ 30,674
Bonded debt, do.	28,290	29 062	29,453	29,317	28,659	28,268
"Cost of road and equipment," do.	51,699	54,301	55,059	55,329	55,461	52,726
Passenger earnings per mile of road in operation	1,756	1.693	1,612	1,801	1,951	1,926
Freight earnings per mile of road in operation	4.649	4,397	4.219	4.382	5.092	4,824
Gross earnings per mile of road in operation	6,861	6,570	6,265	6,663	7.461	7,377
Net traffic earnings per mile of road in operation	2,444	2,376	2,185	2,318	2,702	2.670
Percentage of expenses to earnings	64.45	63.84	65.12	65.21	68.78	63.61
Passenger earnings per passenger train mile	$ 1.008	$ 1.006	$ 0.949	$ 1.001	$ 1.11	$ 1.14
Freight earnings per freight train mile	1.615	1.573	1.518	1.502	1.56	1.59
Gross earnings per revenue train mile	1.445	1.443	1.366	1.410	1 50	1.55
Gross expenses per revenue train mile	0.931	0.921	0.892	0.918	0.96	0.98
Net earnings per revenue train mile	0.514	0.522	0.474	0.492	0.54	0.57
Passenger earnings—proportion of gross	per cent. 25.82	per cent. 25.77	per cent. 26.9	per cent 27.1	per cent. 26	per cent. 26
Freight earnings—proportion of gross	68.38	66.94	67.4	65.9	67	67
Other earnings—proportion of gross	5.80	7.29	5.7	7.0	7	7
Earnings per passenger per mile	cents. 2.276	cents. 2 181	cents. 2.198	cents. 2.356	cents. 2.422	cents. 2.514
Earnings per ton per mile	1.063	1.042	1.057	1.124	1.236	1.236
Average distance per passenger	miles. 24.68	miles. 25.27	miles. 25.99	miles. 26.24	miles. 27.32	miles. 25.89
Average haul per ton	108.79	109.49	112.46	112.07	110.04	109.02
Interest per cent. of bonds	per cent. 4.71	per cent 4.75	per cent. 4.77	per cent. 4.66	.....	.....
Interest per cent. of bonds and debt	4.55	4.53	4.62	4.51	4.59	4.40
Dividends per cent. of stock	2.18	2.04	2.02	2.48	2.75	2.91
Inst. and divid'ds p. c. of stock, bond, and debt	3.40	3.26	3.36	3.52	3.68	3.65

TABLE V.—SHOWING BY STATES AND GROUPS OF STATES THE MILEAGE AND EQUIPMENT OF ALL THE RAILWAYS IN THE U. S. AT CLOSE OF THEIR RESPECTIVE FISCAL YEARS ENDING IN 1887.

States and Groups.	Mileage of Railroads at Close of Fiscal Year.				Equipment.				
						Revenue Cars.			
	Total R.R.	Tot. Trk.	St'l Rails.	I'n Rails	Locomotive Engs.	Pas seng'r.	Bge., Mail, etc.	Freight.	Total.
	M.	M.	M.	M.	No.	No.	No.	No.	No.
1. Maine	1,239 74	1,448.91	893.15	555.76	203	200	98	1,780	2,078
2. New Hampshire	888.18	1,114.72	495.84	618.88	96	92	37	1,916	2,015
3. Vermont	864.86	1,022.78	653.76	369.02	228	142	65	5 643	5,850
4. Massachusetts	2,531.40	4,608.29	3,102.13	1,506.16	1,330	1,889	332	30,146	32,367
5. Rhode Island	149.82	233.54	173.47	60.07	52	112	34	618	764
6. Connecticut	1,009.93	1,407.13	1,033.16	373.97	281	488	179	7,179	7,846
A. New England Group	6,683.91	9,835.37	6,351.51	3,483.86	2,190	2,923	745	47,282	50 950
7. New York	7,552.25	12,735.93	10,132 32	2,603.61	2,792	3,507	619	95,727	99,833
8. New Jersey	1,906.77	3,783.27	1,592.78	2,190.49	854	1,063	132	38,905	40,100
9. Pennsylvania	7,598.70	13 039.62	9,814.11	3,225.51	3,513	2,385	642	217,278	220,305
10. Delaware	254.14	344.11	166.30	177.81	11	18	2	159	179
11. Maryland	1,350.60	2,074.08	1,441.84	632.24	864	655	163	27,108	27,925
B. Middle Group	18,662.46	31,977.01	23,147.35	8,829.66	8,034	7,628	1,558	379,177	388,36
12. Ohio	9 570.39	13,252.65	9,588.25	3,663.80	2,551	1,320	545	99 054	100,919
13. Michigan	5,012.13	6,603.54	4,214.23	2 389.32	814	444	191	22,817	24,452
14. Indiana	5,961.58	6,929.12	4,452.75	2,476.37	1,129	545	289	45,919	46,753
15. Illinois	16,051.92	19,581.64	16,243.72	4,337.92	2,869	1,435	570	94,754	96,759
16. Wisconsin	7,720.26	9,015.75	5,144.27	3,871.48	967	553	293	28,803	29,649
C. Central Northern Group	44.316.28	55,382.10	39,643.21	15,738.89	8,336	4,297	1,888	291,347	297,532
17. Virginia	3,101.27	3,641.72	2,661.90	979.82	693	311	154	17,878	18 343
18. West Virginia	768.40	862.13	622.22	239 91	58	40	13	1,921	1,974
19. North Carolina	1,978.87	2,347.85	1,346.95	1,000.90	122	93	33	1 923	2,049
20. South Carolina	1,939.00	2,157.84	1,184.87	972.97	199	120	63	2,777	2,960
21. Georgia	3,737.21	4,073.01	2,600.35	1,472.66	458	320	161	7,977	8,458
22. Florida	1,926.49	2,026.84	1 243.47	783.37	146	175	91	1,914	2,180
D. South Atlantic Group	13,451.24	15,109.39	9,659.76	5,449.63	1,676	1,059	515	34,390	35,964
23. Alabama	2,441.70	2,715.01	1,786.27	928.74	224	119	68	5,298	5,475
24. Mississippi	708.67	735.45	195.53	539.92	42	30	17	511	558
25. Tennessee	2,915.69	3.372.11	2,437.07	935.04	397	221	84	9,963	10 268
26. Kentucky	2,838.52	3 312.74	2,735.40	577.34	608	346	145	17, 95	17,886
27. Louisiana	1,754.37	1,926.42	945.61	980.81	143	134	64	3,706	3,904
E. Gulf and Miss. Val. Group	10,658.95	12,061.73	8,099.88	3,961.85	1,414	850	368	36,873	38,091
28. Missouri	7.818.58	12,081.27	6,267.37	5,813.90	1,082	630	246	32,709	33,585
29. Arkansas	1,804.21	1,853.17	1,366.29	486.88	147	99	41	4,213	4.353
30. Texas	6,933.14	7,576.63	4,480.46	3,096.17	644	343	136	14,764	15.243
31. Kansas	8,404.33	9 741.17	7,298.13	2,443.04	842	564	248	23,611	24,423
32. Colorado	3,013.52	3,233.39	1,833.21	1,400.18	377	232	94	9,858	10,184
33. New Mexico	931.06	2,001.85	1,848.83	153.02	62	9	9	860	878
F. Southwestern Group	28,904.84	36,487.48	23.094.29	13,393.19	3,154	1,877	774	86,015	88,666
34. Iowa	3,496.77	3,834.75	1,920.86	1,913.89	255	121	68	7,677	7,866
35. Minnesota	8,446.79	9,942.65	7,614.37	2,328.28	1,210	543	269	38 132	38,944
36. Nebraska	3,333.82	3,804.85	2,643.12	1,161.73	401	262	102	8,744	9,108
37. Dakota	521.60	540.60	221.00	319.60	3	1	.....	60	61
38. Wyoming	833.30	866.62	808.39	58.23	40	8	8	1.180	1,196
39. Montana	215.54	216.79	196.40	20.39	.....	.....	.....	.....	.....
G. Northwestern Group	16,847.82	19,206.26	13,404.14	5,802.12	1,909	935	447	55.793	57,175
40. Washington Territory	192.90	200.40	162.70	37.70	8	3	2	150	155
41. Oregon	1 519,00	1,606.21	612.63	993.58	145	78	37	3,064	3.169
42. California	4,265.00	4,843.00	3,109.10	1,733.90	802	790	202	18,065	19,057
43. Nevada	515.45	573.08	378.50	194.58	40	19	10	869	8 8
44. Arizona	609.25	644.55	534.23	110 32	88	42	15	1,474	1,531
45. Utah	1,307.98	1,354.30	695.85	658.45	57	79	30	2,178	2,287
46. Idaho	63.50	66.00	66.00	.....	3	2	1	24	27
H. Pacific Group	8,473.08	9,287.54	5,559.01	3,728 53	1,143	1,013	297	25,754	27,064
RECAPITULATION BY GROUPS OF STATES.									
A. New England Group	6,683.93	9,835.37	6,351.51	3,483.86	2,190	2,953	745	47,282	50,950
B. Middle Group	18,662.46	31,977.01	23,147.35	8,829.66	8,034	7,628	1,558	379,177	388,363
C. Central Northern Group	44.316.28	55.382.10	39 643.21	15,738.89	8 330	4,297	1,888	291,347	297,532
D. South Atlantic Group	13,451.24	15.109.39	9.659.76	5,449.63	1,676	1,059	515	34,390	35,964
E. Gulf and Mississippi Val. Grp.	10,658.95	12.061.73	8.099.88	3,961.85	1,414	850	368	36.873	38,091
F. Southwestern Group	28,904.84	36,487.48	23,094.29	13,393.19	3,154	1,877	774	86,015	88,666
G. Northwestern Group	16,847.82	19,206.26	13.404.14	5,802.12	1,909	935	447	55.793	57,175
H. Pacific Group	8,473.08	9,287.54	5.559.01	3,728 53	1,143	1,013	297	25,754	27,064
United States, 1887	147,998.60	189.346.88	128 959.15	60,387.73	27,850	20,582	6 59	956 631	983.805
United States, 1886	133,606.56	168,047.81	105,723.57	62,324.24	26,415	19 253	6,325	845,914	871.491
United States, 1885	127,729.45	160,597.04	98 102.46	61,491.58	25,937	17,260	6,044	805.5 9	828,853
United States, 1884	125,151.98	156.496.74	90 242.78	66,253.96	24,587	17 309	5,911	798,399	821,613
United States, 1883	120,551.66	149,182.81	78,490.92	70,691.89	23,623	16,889	5,848	778,663	801,400

the past year; their tonnage equalled 11.9 per cent. of the whole. The increase of their tonnage equalled 17.6 per cent. of the increase for all the roads. The increase of their earnings equalled 23.6 per cent. of the whole increase that year. In 1887, their mileage equalled 3.3 per cent. of the total mileage of the United States, and their tonnage equalled 11.8 per cent. of the whole. The increase of their tonnage equalled 10.7 per cent. of the increase for all the roads. The increase of their earnings equalled 9.7 per cent. of the whole increase. These three lines convey to the seaboard the greater portion of the produce of the interior, whether sent forward for domestic consumption or exportation, so that with rates maintained, their traffic is likely to increase in a greater ratio than that of other lines.

The returns from the South for 1887, when considered in connection with the remarkable activity now being exhibited in all branches of industrial enterprise in that section apparently indicate that the long expected era of prosperity which has been so confidently predicted for those States is approaching. In 1887, the mileage of railroads in operation increased 1,229 over the total of 1886, and 1,859 miles over 1884, showing that more than ⅔ of the new mileage added in the past four years was brought into operation in 1887. In the six years from 1881 to 1886, inclusive, there were only unimportant increases in gross and net earnings. During the three years, 1884, 1885 and 1886, earnings per mile were almost stationary, averaging gross about $4,000 per mile, and net about $1,300 per mile. But in 1887, a great change became manifest. The attention of capitalists began to turn to the South—to the development of its coal, iron and other mineral wealth, its lumber and farm lands—and many new industries were introduced. As a consequence, its railroad system has been extended at a rate unequalled in the past, and the earnings of the old lines have increased in ratio to the impetus thus given them.

The percentages of increase in this section are as follows: Gross earnings, 1887 over 1886, 16.4 per cent.; 1887 over 1884, 21.2 per cent. Net earnings, 1887 over 1886, 14.2 per cent.; 1887 over 1884, 19.2 per cent. While the aggregate earnings of the group exhibit such large increases, the mileage statistics make a still better showing. In 1886 the gross earnings averaged $4,005 per mile; the net, $1,334 per mile. In 1887 the gross earnings averaged $4,412 per mile (an increase of $357 per mile); the net, $1,453 per mile (an increase of $119 per mile). It seems probable that when the next number of the MANUAL shall be issued the earnings of these roads will average at least $5,000 per mile.

In the western group of States, comprising all the States west of the Mississippi and Ohio rivers and east of the Rooky mountains, there were in active operation in 1887, 82,367 miles of railroad—an increase over 1886 of 6,712 miles, and over 1884 of 14,939 miles. The aggregate gross earnings for 1887 reached $469,354,779, being at the rate of $5,704 per mile, against a total of $411,733,513, or $5,442 per mile, in 1886; $382,317,857, or $5,336 per mile, in 1885, and $381,901,276, or $5,664, in 1884. Net earnings kept pace with gross, both in aggregate and average per mile, as will be seen by reference to the preceding table. It is noticeable that although the aggregate earnings of this group show a steady and large increase from year to year, the increase per mile is comparatively small. This would seem to indicate that the increase in mileage was out of proportion to the growth of business in that section, but a consideration of the case might qualify this conclusion.

The following table (omitted) shows the mileage, gross earnings and gross earnings per mile of leading western railroads for the past four years, 1884 to 1887; showing that in almost every instance the old established lines have not only maintained earnings, but have made marked increases. The exceptions are few, and where decreases have been made it will be found to have been due almost wholly to aggressive construction, either by themselves or by rival lines. The explanation of the comparatively poor showings made by the West is to be found, therefore, in the fact that the new lines added in the past two years have been almost wholly in new and but partially developed territory.

It is to be noted, however, that these new lines have been constructed almost entirely by the largest and strongest of the old companies, into a territory which will very speedily contribute traffic enough for their support, and with the movement of this year's crops, these new lines will probably not only do a remunerative business for themselves, but increase by its full amount, the business of the old lines reaching to Chicago which constructed them. The manner in which this construction was done by the old companies brought complete and efficient lines to the frontier, which could offer at the outset complete transportation facilities to the country, and thus promote its rapid development.

A study of the figures of the Pacific group shows an increasing business in that section. Owing to the present system of reporting the Southern Pacific returns, and the late hour in which they were received, it is impossible to make for this group an intelligent comparison with previous years.

Taking the entire system together, the showing made is highly satisfactory. The great decrease in the average "cost of road and equipment" in the past 2 years is worthy of note, resulting from the reduced cost of construction. This decrease is accompanied by corresponding decreases in stock and bonds per mile.

Various other tables giving details of mileage, traffic, etc., as noted elsewhere, are then given, and the introduction is closed by a reproduction of the ENGINEERING NEWS Map No. 9, which appeared in our issue of June 16, showing the construction of the entire United States for 1886, 1887 and part of 1888, with an extended quotation from our editorial of that issue as to the distribution of construction.

WHAT will not the inventive genius of the newspaper reporter devise in the line of railroad appliances! The climax seems to be reached in a recent proposition to fit up the roofs of vestibule cars as a "summer garden" with a fountain in the centre surrounded by tropical plants and flowers, while hammocks, canopies, bird music etc., render the place an elysium. We are only surprised that the scheme was not rounded out and made complete by the addition of a tennis court and a trout stream.

TABLE VI.—*Showing by States and groups of States [separate States omitted, Ed.] the mileage of railroad operated, traffic operations, gross and net earnings, interest and dividend payments, etc., etc.*

STATES.	Length R. R. Worked (and reported).	REVENUE TRAIN MILEAGE.				PASSENGER TRAFFIC.		FREIGHT TRAFFIC.		GROSS TRAFFIC EARNINGS.			Net Earnings.	Total Available Revenue.
		Passenger.	Freight.	Mixed.	Total.	Pass'ng's Carried.	Passenger Movement.	Freight Moved.	Freight Movement.	From Pass'gers.	From Freight.	Total (includin Miscel's)		
A. N. Engl'd Gr.	6,984.88	23,829,794	19,687,688	1,491,543	45,008,025	93,483,949	1,482,312,733	34,907,5 3	2,141,588,080	29,116,085	33,539,464	66,324,051	19,266,191	24,686,627
B. Middle Group	18,976.60	66,611,949	109,654 097	2,840 085	179,106,131	176,361,731	3,059,957,868	235,034,608	20,251,018,698	64,023,536	184,006,221	254,258,795	94,648,430	133,200,007
C. Cent. Nor. Gr.	44,054.58	75,366,129	143,484,570	3,209,104	222,059,803	87,292,882	3,027,621,204	165,694,761	23,253,827,416	68,855,990	198,674,931	285,471,457	100,670,367	111,020,681
D. S. Atlant Gp.	11,738.69	13,089,995	19,932,925	1,914,725	34,967,555	11,315,150	396,245,486	21,354,256	2,329,458,551	11,005,557	28,546,171	43,909,351	13,654 210	16,617,057
E. G. & M. V. Gr.	8,513.93	11,813,671	19,431,861	784,304	32,029,836	11 379,600	438,688,840	24,822,850	2,543,625,018	10,623,183	31,590,070	44 905,458	15,472,733	19,657,714
F. So. West. Gr.	22,987.20	24,414,524	42,103,066	213,290	66,730,880	18,421,275	923 887,906	33,897,451	5,057,130,003	26,092.063	77,320,674	112,018,500	38,532,461	45,874,803
G. N. West. Gr.	15,325.23	13.769,802	25.763,360	257,612	39.790,774	13,502,021	614.419,651	24,496,253	3,948,535,382	16,542,726	50,880,294	72,344,522	28,259,250	35,775,221
H. Pacific Group	8,405.38	9.860,146	14,103,540	322,206	24,285,892	16,468,905	627.173,022	11,867,050	2,535,883,848	14,283.736	32,108,398	52,153,020	20,632.034	26,467,921
U. S., 1887	136,986.49	238,755,920	394,191,107	11,031,869	643,978,896	428,225,513	10,570,306,710	552,074,752	62,061,069,996	240,542,876	636,666,223	931,385,154	331,135,676	414,300,031
U. S., 1886	125,146.50	210,637,892	349,697,537	9,437,561	569,772,990	382,284,972	9.659.698,294	482,245,254	52,802,070,529	211,929,857	550,359 054	822,191,949	297,311,615	363,511,704
U. S., 1885	122,110.16	211,587,620	342.288,770	6.297,575	560,173,965	351,427,688	9,133,673,956	437,040,099	49,151.894,469	200,883,912	509,690,992	765,310.419	266.488,993	352,881,470
U. S., 1884	113,172.66	206,516.118	334,814,529	.....	541,330,647	334,570,766	8,778,581,061	399,074,749	44.725,207,677	206,790,701	502,869,910	763,306 608	267,513,911	349,756,172
U. S., 1883	106,938.49	187,903.247	350,108,255	.....	538,011.502	312,686,641	8,541,309,674	400,453,439	44,064.923.445	206,837,256	539,509,831	807,112,780	291,587,588	359,942,327

TABLE VII.—*Showing the amount of bonded debt on which interest was paid during the two years, 1882 and 1886; the relative percentage of such amounts, etc., etc., [amounts omitted, Ed.]*

STATES.	1882.				1886.			
	Int. Paid.		Bonded debt per cent.		Int. Paid		Bonded debt Per cent.	
	Per cent.				Per cent.			
	Tot'l	Pro-d'ct'e	Pro-d'ctive	Non Pro-d'ctive	Tot'l	Pro-d'ct'e	Pro-d'uctive	Non-Pro-d'ctive
Maine	4.87	5.13	91.93	5.07	4.85	5.18	93.69	6.31
New Hampshire	4.80	5.57	83.10	16.90	5.57	5.74	97.08	2.92
Vermont	2.21	5.57	39.58	60.42	2.66	6.33	41.95	58.05
Massachusetts	5.84	5.96	97.99	2.01	5.01	5.10	98.21	1.79
Rhode Island	5.85	6.03	92.73	7.27	6.37	6 50	98.11	1.89
Connecticut	6.12	7.17	85.29	14.71	5.34	5.53	96.65	3.35
New Eng. Gr.	5.18	5.88	88.18	11.82	4.80	5.26	91.28	8.72
New York	4.64	5.51	84.19	15.81	3.80	4.15	91.53	8.47
New Jersey	5.56	6.38	87.15	12.85	8.59	9.30	92.33	7.67
Pennsylvania	5.12	5.30	96.59	3.41	5.23	5.40	96.95	3.05
Delaware	4.77	4.77	100.00	.....	.91	.91	100.00	.....
Maryland & D. C.	4.85	5.07	95.57	4.43	7.57	8.38	90.38	9.62
Middle Gr.	5.01	5.52	90.73	9.27	5.16	5.48	94.05	5.95
Ohio	3.29	4.01	82.06	17.94	3.25	3.84	84.56	15.44
Michigan	5.08	5.58	91.07	8.93	5.24	5.87	89.33	10.67
Indiana	5.41	6.31	85.81	14.19	2.75	2.84	97.05	2.95
Illinois	5.09	5.77	88.05	11.95	5.61	6.16	91.28	8.72
Wisconsin	4.61	4.94	93.27	6.73	4.82	5.27	91.49	8.51
Centr. No. Gr.	4.47	5.16	86.58	13.42	4.38	4.87	89.93	10.07
Virginia	3.70	4.14	89.40	10.60	3.49	4.43	78.64	21.36
West Virginia	1.19	5.29	22.51	77.49	3.17	6.10	51.96	48.04
North Carolina	1.89	3.21	58.87	41.17	3.04	3.27	92.77	7.23
South Carolina	4.86	5.88	82.92	17.08	4.37	4.89	90.00	10.00
Georgia	3.14	5.54	56.69	43.31	5.10	7.02	74.06	25.94
Florida	1.07	4.35	24.54	75.46	3.11	4.81	64.73	35.27
So. Atl. Gr.	3.33	4.59	72.52	27.48	3.85	4.93	78.08	21.92
Alabama	4.36	4.90	88.78	11.22	4.38	4.79	91.54	8.46
Mississippi	3.85	4.65	81.94	17.06	3.72	4.97	74.55	25.45
Louisiana	4.80	5.83	82.18	17.81	4.37	4.52	96.84	3.16
Tennessee	4.23	4.41	95.99	4.01	5.61	7.38	76.12	23.88
Kentucky	4.67	4.87	95.81	4.19	2.32	2.70	85.93	14.07
Gulf & Miss. V.	4.51	4.91	91.94	8.06	3.74	4.40	85.69	14.31
Missouri	5.94	6.25	95.02	4.98	5.74	6.19	92.73	7.27
Arkansas	1.71	5.10	33.44	66.56	1.93	2.69	72.95	27.05
Texas	4.35	5.31	81.85	18.15	2.69	5.23	51.35	48.65
Kansas	5.23	8.65	60.44	39.56	5.53	6.23	88.96	11.04
Colorado	5.64	6.06	94.18	5.82	3.03	3.34	90.64	9.37
New Mexico	.90	6.00	82.28	17.72	1.24	1.35	91.99	8.01
So. West Gr.	4.84	6.21	78.00	22.00	5.16	4.11	79.74	20.26
Iowa	4.83	5.10	96.31	3.69	4.73	5.61	84.37	15.63
Minnesota	5.24	5.79	90.51	10.49	5.76	5.88	97.89	2.11
Nebraska	5.84	5.97	97.80	2.20	4.35	4.26	99.74	.26
Dakota	.....	.....	.....	100.00	6.91	6.91	100.00	.....
Wyoming	.....	.....	.....	100.00	6.00	6.00	100.00	.....
Montana	.....	.....	.....	.....	7.00	7.00	100.00	.....
No. West Gr.	5.45	5.76	92.78	7.22	5.10	5.26	96.83	3.17
Idaho	.....	.....	.....	.....	.....	.....	.....	.....
Washington	.....	.....	.....	100.00	1.75	6.00	29.10	70.90
Oregon	5.17	5.94	87.10	12.90	2.47	4.95	50.04	49.96
California	4.55	4.80	94.79	5.21	3.93	4.64	97.25	2.75
Nevada	5.00	6.99	72.41	27.59	8.87	11.88	7.47	92.53
Arizona	5.84	6.00	97.33	2.67	5.12	5.90	86.87	13.13
Utah	3.62	6.54	55.30	44.70	4.48	4.78	93.67	6.33
Pacific Gr.	4.58	5.12	89.37	10.63	3.77	4.31	87.29	12.71
United States	4.71	5.42	86.84	13 16	4.52	5.08	89.12	10.88

NOTE.—The "productive bonded debt" excludes bonds of new railroads in process of construction, the first coupon on which had not matured at close of their respective fiscal years. This brings under the head of "non-productive bonded debt" a large amount of bonds, the interest on which will be paid.

TABLE VIII. *Showing the relation of railroad mileage to population and area in the United States from 1880 to 1886 (based on the population of the Census of 1880), and gross and net earnings.*

STATES.	Population per Sq. Mile.	Square Miles per mile of R. R.	Population per mile of Railroad.		Earnings per mile of Road.						Interest Payments per mile of railroad in 1886
					Gross.			Net.			
	1880.	1886.	1880.	1886.	In 1886.	Avg. 1880 to '86.	In. or Dec. 1886 over 1880	In 1886.	Avg. 1880 to '86.	In. or Dec. 1886 over 1880	
					$	$	$	$	$	$	$
Me	19.64	28.73	645.71	564.62	4,713	4,348	I. 864	1,746	1,402	I. 344	1,089
N. H	37.29	8.86	341.86	330.41	7,237	5,528	I. 2,379	2,868	1,802	I. 1,704	1,083
Vt	34 74	10·10	363.55	350.98	4,991	4,940	I. 53	1,514	1,266	I. 304	598
Mass	146.03	4.12	911.11	883.39	12,276	12,207	I. 753	3,664	3,554	D. 348	1,455
R. I	221.22	5.95	1,316.81	1,316.81	11,446	10,346	I. 2,754	3,751	3,539	I. 486	1,012
Conn	127.08	5.02	674.65	638.30	11,719	10,828	I. 2,443	4,018	3,428	I. 369	641
New Eng	60.42	10.45	670.99	631.57	9,744	8,957	I. 1,713	3,091	2,686	I. 259	1,129
N. Y	103.37	6.57	818.42	679.40	10,335	11 223	D. 1,734	2,490	3,656	D. 1 196	2,227
N. J	144.74	3.99	671.69	577.86	17.679	15,757	671	4,543	5.994	D. 1,662	8,486
Penn	94·72	5.74	691.79	544.09	15,320	15.481	I. 606	6,379	6,378	D. 545	2,928
Del	71.50	6.31	533.12	438.29	4,555	3.790	1,722	699	1.727	D. 148	63
Md	2,537.49	3.18	1,069.78	755.90	10,881	11,679	D. 1,327	4,253	4,707	D. 1,125	8,851
	76.57	9.97	.....	8 219.53	.....	.....	.....	.....	.....	.....	.....
Middle	100.88	6.17	774.39	622.30	13,086	13,344	D. 515	4,869	4,945	D. 869	3,447
Ohio	77.89	5.51	552.15	423.91	7,788	8,630	D. 1,418	2,528	2,671	D. 1,110	1,412
Mich	27.78	10.45	415.68	290.45	6,222	5,741	I. 385	1,913	1,667	D. 116	1,201
Ind	54.42	6.37	452.39	346.39	4,603	5,315	D. 1,551	1,165	1,276	D. 713	641
Ill	54.33	6.11	392.04	331.82	6.251	6,287	D. 978	2,532	3,014	D. 1,253	1.199
Wisc	23.47	11·51	416.96	270.17	4,243	4,252	I. 274	1,737	1,691	I. 161	1,072
C. No	45.01	7.56	446.31	340·12	5,984	6,337	D. 616	2,138	2,290	D. 775	1,130
Va	35.63	15.55	799.03	554.09	4,956	4,748	I. 336	1,894	1,713	I. 191	1,119
W. Va	24.96	21.60	890.43	539.28	3,829	3.294	I. 854	1,092	892	D. 163	985
No. Car	26·78	23·73	941.96	635.79	2,107	2.297	I. 68	676	692	I. 16	478
So. Car	32·57	16.85	697.67	548.95	3 912	3,096	I. 1,064	689	873	D. 197	745
Ga	25·93	17·54	627.16	454·85	3,574	3,482	I. 226	1,043	1,123	D. 329	930
Fla	4.59	30·59	520.26	140·49	2,254	1,731	I. 715	621	517	I. 366	643
S. Atl	23·63	20.31	747·93	480·15	3,599	3,457	I. 362	1,171	1,131	D. 7	875
Ala	24·16	22.91	685.03	553.62	3 814	4,702	I. 620	1,055	1,194	D. 75	888
Miss	24·17	22·17	1,004.08	535.95	3,329	3,338	I. 1,243	603	1,060	D. 501	1,161
T nu	36.68	19·12	836.87	701.36	3,556	3,746	D. 580	1,274	1,326	D. 276	597
Ky	40·81	19·08	1,077.37	778 91	6,149	5,686	I. 1,732	2,405	2,289	I. 417	1,902
La	19·29	35·28	1,441.61	680·55	7,017	8,896	I. 2.395	1,895	2,998	I. 511	2,917
Gulf & M	27.04	22·82	932.82	646·80	4,633	4,947	I. 780	1,535	1,753	.....	1.274
Mo	31.24	13·69	516.88	427.83	5,919	6,508	D. 958	2,446	2,816	D. 402	1,721
Ark	14·90	24.52	935.25	365.50	2,562	3,545	D. 934	752	984	D. 810	502
Tex	5·99	36·43	490·68	218·19	3,847	4 186	D. 486	791	1,222	D. 1,075	767
Kans	12.14	13.41	292·97	162·77	5,329	5,831	D. 63	2,291	2,116	D. 233	1.240
Colo	1·87	35.30	123.77	66·02	4 768	4,849	D. 2,569	1,500	1,580	D. 2,109	704
N. Mex	0·98	99.42	157.74	96·97	1,061	4,456	D. 2,496	df.36	80	D. 116	556
Ind. Terr	.....	149·75	.....	.....	.....	.....	.....	.....	.....	.....	.....
S. W	8·42	30·15	416 94	232·23	4,733	5,326	D. 1,107	1,659	2,011	D. 823	1,132
Ia	29·00	7.06	300.85	205.12	2,617	2,985	D. 476	636	1,676	D. 677	951
Minn	9·37	17.28	247.49	161.88	4.516	4,822	I. 1,015	2.004	2,016	I. 454	1 391
Neb	5·88	21.25	231.64	125·11	7,703	8,967	I. 444	3.113	4,463	D. 478	2,225
Dak	0.97	40.32	110·35	36.55	4.696	3,350	I. 3,643	df.750	97	D. 847	24.215
Wyo	0·21	125·82	40.60	26·73	3,114	2,020	I. 1,094	948	620	I. 328	1,436
Mont	0·27	137·55	369.42	36.86	13,579	13,320	I. 259	1.446	2,533	D. 1,087	11,158
N. W	5·01	27.81	247·25	139·78	4,716	5,372	I. 1,015	1,892	2,310	D. 938	1,509
Wash	1·09	77·04	260.00	83·06	3.802	4,656	D. 854	1,359	2,076	D. 717	472
Id	1.82	78.78	158.30	40·19	6,357	6 689	D. 993	2,712	2,871	D. 276	734
Or	5.46	48·03	344·09	143.16	6,633	7,522	D. 1,028	3,057	3,062	I. 213	1,549
Cal	0 56	116·04	393.94	262·29	4.470	6,669	D. 4,100	1,902	2,9.5	D. 1,185	323
Nev	0·36	114.28	84.26	65·26	2,226	2,376	D. 150	1,423	1 345	I. 78	9,407
Ariz	1.69	74·60	115.87	40·89	3,292	2,286	D. 456	994	939	D. 694	727
Utah	0.38	104 56	170·98	126.39	.....	.....	.....	.....	.....	.....	.....
Pacific	1·94	77·05	271·81	149·76	5,813	6,168	D. 1,722	2,529	2 520	D. 299	1,308
U. S	16·98	21·89	537.59	363·49	6,570	6,989	D. 737	2.376	2.560	D. 626	1,497

[NOTE. The population of the United States was probably about 18 per cent. larger in 1886 than in 1880, or about 59,000,000. Hence the true population per mile of road in 1886 was probably about 429 per mile of road instead of 363.49. Similarly, all the figures for the last column are seriously out because of the different rate of growth, which for the Western States has been very rapid. Between the Census of 1870 and 1880 the New England States increased 15.03 p. c. in population, the Middle, 20.25; the Southern, 28.82; the North-West Central States (Ohio to Iowa and Minnesota) 26.45; the Far West and South West 126.3, and the Pacific States 64.86 per cent., the average for the whole U.S. having been 30.06 per cent.—ED. ENG. NEWS.]

TABLE IV.—COMPARATIVE STATEMENT OF AVERAGES BY GROUPS OF STATES FOR 1887.

	New England Group.	Middle Group.	Central Northe'n Group.	South Atlantic Group.	G. & M. Valley Group.	South western Group.	North western Group.	Pacific Group.
Per Mile Completed Road.								
Capital Stock	$ 33,801	$ 57,982	$ 23,688	$ 19,888	$ 21,739	$ 23,470	$ 22,368	$ 30,443
Bonded Debt	20,931	57,451	24,868	19,911	27,640	22,594	25,485	26,881
"Cost Road and Equip't"	52,613	97,043	46,536	36,014	48,809	43,429	48,125	61,054
Per Mile in Operation.	$	$	$	$	$	$	$	$
Pass. Earnings	4,168	3,373	1,563	937	1,247	1,155	1,079	1,699
Freight Earnings	4,801	9,696	4,509	2,431	3,710	3,363	3,320	3,820
Gross Earnings	9,495	13,560	6,479	3,740	5,274	4,873	4,720	6,205
Net Traffic Earnings	2,758	5,067	2,284	1,163	1,817	1,676	1,844	2,455
Percent. Exp. Earnings	70.96	62.78	64.74	68.91	65.55	65.61	61.48	60.44
Per Revenue Train Mile.	$	$	$	$	$	$	$	$
Pass. Earnings	1.221	0.961	0.913	0.847	0.899	1.068	1.201	1.448
Freight Earnings	1.703	1.677	1.385	1.429	1.625	1.788	1.967	2.276
Gross Earnings	1.473	1.419	1.286	1.255	1.401	1.677	1.818	2.147
Gross Expenses	1.045	1.891	0.833	0.865	0.918	1.100	1.108	1.298
Net Earnings	0.428	0.528	0.453	0.390	0.483	0.577	0.7 0	0.849
Proportion of Gross Earn'gs.	p. c.	p. c.	p. c.	p. c.	p. c.	p. c.	p. c.	p. c.
Passenger	43.89	25.18	24.12	25.06	23.65	23.29	22.86	27.38
Freight	50.56	72.36	69.59	65.01	70.34	69.02	70.33	61.56
Other	5.55	2.46	6.29	9.93	6.01	7.69	6 81	11.06
	Cents.	Cents.	Cents.	Cents.	Cents.	Cents.	Cents.	Cents.
Earnings per Pass. per mile	1.964	2.092	2.274	2.777	2.421	2.824	2.692	3.277
Earnings per ton per Mile	1.566	0.908	0.854	1.225	1.242	1.529	1.288	1.266
	Miles.	Miles.	Miles.	Miles.	Miles.	Miles.	Miles.	Miles.
Av. Distance per Passenger	15.85	17.35	34.68	35.01	38.55	50.15	45.50	38.08
Av. Haul per Ton	61.35	80.03	140.34	109.08	102.47	149.18	161.18	213.69
	p. c.	p. c.	p. c.	p. c.	p. c.	p. c.	p. c.	p. c.
Int. per cent. of Bonds	4.59	5.39	4.51	3.46	3.90	4.03	4.75	5.94
Int. per c. of Bonds & Debt	4.31	5.14	4.49	3.61	3.81	3.78	4.36	5.89
Divid'ds per cent. of Stock	4.51	2.68	2.91	0.69	0.23	1.86	0.97	0.71
Int. & Divid'd p. c. of Stock, Bonds & Debt	4.43	3.95	3.75	2.18	2.18	2.81	2.85	3.18

The New Tower Bridge,

The London *City Press* publishes the following figures (and comparison with London Bridge) in respect to the new bridge which is being constructed over the Thames, under the direction of the Corporation :—Total length of bridge, 940 ft. ; total length of bridge and approaches, 2,640 ft. ; opening span, width, 200 ft. ; opening span, headway, when opened, 135 ft. ; opening span, headway, when shut, 29 ft. 6 in. ; side spans, width, 270 ft. ; side spans, headway, from 20 ft. to 27 ft. ; width between parapets, opening span, 50 ft. ; width between parapets, side spans and approaches, 60 ft. ; steepest gradient of approaches, 1 in 40 (steepest gradient of approaches of London Bridge, 1 in 7) ; depth of foundations, 60 ft. below Trinity high-water mark, 27 ft. below bed of river ; sectional area of waterway, 20,040 sq. ft. (London Bridge, 19,300 sq. ft) ; depth of water in opening span at high water, 33 ft. 6 in. ; depth of water in opening span at low water, 13 ft. 6 in. Estimated quantities of materials in the bridge and approaches—Bricks, 31,000,000 ; concrete, 70,500 cu. yds. ; cement, 19,500 tons ; granite and other stone, 235,000 cu. ft. ; iron and steel, 10,500 tons. Machinery etc. :—Two steam pumping engines for hydraulic machinery, each 360-horse power, eight large hydraulic engines and six accumulators, four hydraulic lifts in towers for passengers ; size of each leaf of opening span, 50 ft wide by 100 ft. long ; weight of each leaf of opening span, including roadway and counterbalance weights, 700 tons ; estimated cost, £750,000. The engineer is Mr. J .WOLFE BARRY ; the contractors are—for foundations, Mr. J. JACKSON ; for machinery, Sir W. ARMSTRONG, MITCHELL & COMPANY (Limited.)

THROUGH the liberality of Mr. W. B. CHAMBERLAIN, of Denver, Col., that city is to have an astronomical observatory. The telescope promised is to have a 20-in. object glass, with a 26-ft. tube of best rolled steel.

SOCIETY PROCEEDINGS.

American Society of Civil Engineers.—The first regular meeting of the session was held Sept. 5., and a paper on "The Theory of Aqua-Ammonia Engines, with Results of Tests upon an engine of this Type operating an Edison Incandescent Lighting Plant" was read by E. E. MAGOVERN, Jun. Am. Soc. C. E. The first part of the paper dealt with the desirability of obtaining some fluid or gas which will utilize a greater percentage of the heat to be obtained from coal, and, in discussing the theory of aqua-ammonia engines, gave a number of references to authorities and works with regard to the subject. The tests were made with a horizontal return tubular boiler, 42 in. shell and 10 ft. long, supplying steam to a Porter-Allen engine, with single cylinder 11½ ins. by 20 ins. the engine drove two Edison dynamos. The result of the test, as to power, was that while with steam about 32 H. P. were developed ; about 58 H. P. were developed when the weak solution of aqua-ammonia was used. There was no collation after the meetings, the funds for this purpose having been "swallowed up;" a subscription list was posted conspicuously, however, and the secretary called attention to the fact that the collations, which are a pleasant feature of the meetings, are not provided for out of the Society funds, but entirely by voluntary subscriptions from resident members.

The following candidates were declared elected :

Members.

WILLIAM JAMES BALDWIN, New York City.

ELBRIDGE LEONARD BROWN, Brockton, Mass.

ENWARD BERTIE CODWISE, Chf. Eng., Ulster & Delaware R. R., Kingston, N. Y.

WALTER WHALEY CURTIS, Res. Eng., Fort Madison Bridge, Fort Madison, Ia.

ARTHUR POWIS HERBERT, Loc. Eng., Mexican National Construction Co., City of Mexico.

EDWARD MAGUIRE, Capt. of Engs., U. S. A., Willetts Point, N. Y.

ARTHUR JOHN MASON, Asst. City Eng., Kansas City, Mo.

CHARLES HENRY NASH, Bloomfield, N. J.

WILLIAM SCHERZER, Keystone Bridge Co., Chicago, Ill.

WILLIAM HUMPHREY WIGHTMAN, Asst. Eng. in Charge of Construction, Spokane & Palouse Ry., Palouse, Wash. Ty.

Associate.

WM. GIBSON, Jr., "*Engineering and Building Record*", New York City.

Juniors.

ST. JOHN CLARK, Res. Eng. for Passaic Rolling Mill Co., at the Manhattan Bridge, High Bridge, N. Y.

WALTER H. GAHAGEN, Asst. Res. Eng., I. V. & N. R. R., La Salle, Ill.

MASON DELANO PRATT, Asst. Eng., Johnson Steel Street Rail Co., Johnstown, Pa.

CONSTRUCTION NEWS.

RAILROADS.

East of Chicago.

Existing Roads.

Buffalo, Rochester & Pittsburg.—It is stated that the system of train collectors will be put in force on this road on Oct. 1.

Cincinnati, Hamilton & Dayton.—The Piqua & Troy branch has been quietly extended through the city of Piqua, O., and it is surmised is to be pushed north to a connection with the Chicago & Atlantic at Decatur, Ind. Just now work has been stopped by disputes concerning the right of way.

Cincinnati, Wabash & Michigan.—The option held by H. S. IVES on the controlling interest in the stock of this company held by its President, J. H. WADE expired on Aug. 29 and the stock reverts to Mr WADE ; IVES losing the amount paid down, $410,000. It is probable that the southern extension to Rushville, Ind., which was located last year will be undertaken at once, now that the doubt regarding the future control of the line is removed.

New York Central & Hudson River.—The double tracking of the Charlotte branch in western New York is completed.

New York & New England.—The first train over the extension of the New Haven & Derby road from Derby to Hawleyville was run on Aug. 30.

Maine Shore Line.—Grading has been suspended on this road. Only a small amount of work was done near Machias. Funds are not at hand to build the road, and the subscriptions of local aid will not be forthcoming till the work is farther advanced.

Canadian Pacific.—The Town Council of Chatham, Ont., has voted to submit a by-law granting a bonus of $40,000 to aid the extension from London to Windsor.

Maryland Central.—This line, 44 miles in length, from Baltimore, Md., to Delta, Pa., will be sold at foreclosure sale on Dec. 10 next at Towsontown, Md.

Midland of Indiana.—H. MOORE, who has been appointed Receiver of this road, says its debts will not exceed $1,000 per mile.

Louisville, New Albany & Chicago.—The rumor which has been so persistently circulated that this road was to be leased to the Cincinnati, Hamilton & Dayton, is now eclipsed by the report that the controlling interest has come into the hands of M. E. INGALLS, President of the Cincinnati, Indianapolis, St. Louis & Chicago and the Chesapeake & Ohio systems.

Wharton Valley.—The contract for building this branch of the New York, Ontario & Western from New Berlin to Edmeston, N. Y., has been let to W. R. HAVEN of Middleton.

New York, Mahoning & Western.—On Aug. 29 liens were filed against this company by the Mahoning Construction Co., the Allegheny Construction Co., and various contractors and employés, amounting in all to $153,000. A Receivership seems to be inevitable.

New Projects and Surveys.

WELLSVILLE, Ohio, August 28.—Another railroad is talked of in this vicinity. For several days a corps of engineers have been working very quietly in this neighborhood, and it developes to-day that they are surveying from the extensive Berghabe coal regions, following the course of Yellow Creek to the Ohio river at this point, from which it will be extended to Pittsburg. The Carnegies, the wealthy iron men of Pittsburg, are said to be at the bottom of the scheme.—Cincinnati *Enquirer*.

SOUTHERN

Existing Roads.

Chesapeake & Ohio.—According to the circular letter of C. H. Davis & Co., about 98 per cent. of all the security holders have assented to the terms of the proposed reorganization and, deposited their securities with Drexel, Morgan & Co.—The company began operating the Richmond & Allegheny Railroad under lease on Sept. 1.

Central Railroad of Georgia.—The city of Montgomery, Ala., is interested in the report that the company intends to establish extensive repair shops at that point.—It is stated that the company will offer $40,000 per month rental at the next session of the Georgia Legislature for a lease of the Western & Atlantic Railroad.

Louisville & Nashville.—A report is afloat that the extension which is now in progress from Birmingham to Huntsville, Ala., is to be more than a local line and is to be pushed on "through Eastern Tennessee, passing near Jellico and connecting with a branch of the Louisville & Nashville road at Pineville, Ky., on the line of the Cumberland mountains. From the last named point the road will proceed about 50 miles along the Kentucky side of the mountains, when it will cross at Bull's Gap to the Virginia side. From thence the line will run along parallel with the line of the East Tennessee, Virginia & Georgia."—It is stated that the company will also put in a bid for the Western & Atlantic Railroad, offering $50,000 per month for a 99-year lease.

Chattanooga, Rome & Columbus.—The Atlanta *Constitution* publishes an interview with President J. D. WILLIAMSON in which he is quoted as follows :

"The road will be built to Atlanta, Columbus and Montgomery, and if we succeed in making suitable and profitable connections at Columbus, it will be one of our southern terminal points. If we do not succeed in making satisfactory arrangements at that point the Chattanooga, Rome Columbus will be built into Florida."

"I have succeeded in interesting a strong syndicate of European and Northern capitalists in the road, and it will be extended wherever business justifies it. Of course we do not intend to make extensions into territory that does not promise a fair return on the investment, and the future of the road is dependent entirely on the success of the projected extensions."

"We are doing a very good business on our line from Chattanooga to Carrollton considering the fact that we have been in operation but a short time ; and the prospects for that division becoming a paying one are good. The extension from Carrollton to Atlanta will of course add greatly to the importance of the road ; and I believe will also prove a good thing for Atlanta."

"I cannot say positively when we will begin work on these extensions, but I think it probable that within two months we will have them well under way."

Cape Fear & Yadkin Valley.—A corps of engineers are on the field locating the extension from Mt. Airy, N. C., to connect with the Norfolk & Western branch, which is also under survey.

Norfolk & Western.—The company is building a new $50,000 passenger depot at Lynchburg, Va.

East Tennessee, Virginia & Georgia.—The plans are completed for a new Union depot at Selma, Ala., to cost about $100,000. The building will be of pressed brick with stone trimmings. Bids for its construction are to be opened soon.

Nashville & Knoxville.—Trains are now running from Lebanon to Gordonsville, on the Nashville & Knoxville Railroad. The company will extend the line from Gordonsville to Carthage, as soon as the subscription voted by Smith county is paid. Boats will then be placed in the Cumberland river for the transportation of coal from the mines owned by A. L. CRAWFORD, of New Castle, Pennsylvania, the president of the company.

St. Cloud Sugar Belt.

KISSIMMEE CITY, Fla., Aug. 31, 1888.

EDITOR ENGINEERING NEWS:

The St. Cloud Sugar Belt Railroad will run from Kissimmee City to Runnymede, *via* St. Cloud, a distance of 12 miles. There are 6,000 ft. of trestles on the line; rails are 50 lb. steel; work is finished on the grading contract and tracklaying will begin Sept. 10. The line will probably be open for traffic by Oct. 1, and will do business as a common carrier of both classes of traffic, freight and passenger. The line is projected to develop sugar lands, the town of Runnymede, etc. T. S. THURBER, Kissimmee City, Fla., is Chief Engineer.

JOHN L. HILL, *General Manager.*

Atlantic & Danville.—Tracklaying has been completed from Norfolk to Hicksport, Va., a distance of 75 miles, and trains began running on Sept. 4. Grading is in progress between Hicksford and Lawrenceville, Brunswick Co., and it is expected to run trains to that point by Jan. 1.

SUFFOLK, Va., Sept. 5, 1888.

EDITOR ENGINEERING NEWS:

The Atlantic & Danville R. R. Co. has completed the construction of its line as far west as Belfield, Va., and is now open for traffic between that point and Norfolk, (Va.) It has 20 miles more under construction which will be completed this fall and will carry the western terminus to Lawrenceville, the county seat of Brunswick Co. The company expects to push the line on towards Danville as rapidly as possible. F. L. PITMAN, *Chf. Eng.*

Cincinnati, Selma & Mobile.—An interview with President CECIL GABBETT in the Montgomery *Advertiser* quotes the following statements in regard to the extension from Akron, Ala., Aberdeen, Miss.

"I am going to New York in the interest of the C., S. & M., or rather I am going to partly arrange the preliminaries of the work of extension.

"I cannot say when work will begin; but I do not think that dirt will be thrown until the latter part of the winter. The railroads need all of their money to handle business during the winter, and it is mighty hard to watch a big business and build a branch road at one and the same time. But I feel justified in saying that with the opening of next spring the work on the extension will be well under way, and I hope to have the 80 miles between Akron and Aberdeen in full blast by the fall of 1889 if not before then.

"I think the road will be under the control of the Western, and will form one continuous line from Aberdeen to Atlanta, being about 300 miles in a direct line. The road will make a special object of developing all of the country through which it will pass, and I think will be the salvation of the fine, fertile farm lands which lie between the two terminal points.

Atlantic Coast Line.—A surveying party is in the field locating a line from near Balards, on the Fredericksburgh Railroad, through Chesterfield county to a point on the Petersburgh railroad. The line will obviate the transfer of through freight cars through the streets of Richmond, Va. Work will probably begin soon on its construction.——On the Manchester and Augusta extension, tracklaying is in progress between Sumter and the Santee river.— The Florence railroad is being extended from Dillon's ten miles toward Fayetteville.

Atlanta & Florida.—Chief Engineer COLLIER is in the field with a party examining the routes for the extension from Ft. Valley, Ga., south.

Richmond & Danville.—The contracts have been closed for the construction of the Chowan & Southern extension from Norfolk, Va., to Tarboro, N. C., the work to be finished by Apr. 1, 1889. The contractors will put on 2,000 hands at once.

Nashville, Chattanooga & St. Louis.—Ground was broken last week for the new shops at Nashville, Tenn. The total cost of the land, shops and equipment is estimated at $250,000.

Rome & Decatur.—This property is again in the courts, Receiver RUFUS T. DORSEY having sued for its possession, it being still in the hands of the contractor, D. CALLAHAN.

New Projects and Sureys.

Memphis & Atlantic.—At the election of officers of this company, recently held at Columbus, Miss., F. M. ABBOTT, was elected President, BELL PRICE, Secretary and Treasurer and J. A. ORR, General Solicitor. The company is now trying to secure the amount of local aid asked from the city of Memphis; and if successful, promises to begin work at once.

Columbus, Fulton & Eastport.—The directors of this company held a meeting recently at Aberdeen, Miss., and voted to issue $50,000 in bonds to begin work on the line.

Owensboro, Falls of Rough & Green River.—The contract for building this Kentucky road has been awarded to J. M. W. FIELD of Owensboro. He agrees to build the road from Owensboro to Fordsville, a distance of 27 miles, lay the necessary side tracks at the various stations, and put on rolling stock sufficient to operate two trains in consideration of the $75,000 subsidy of the city of Owensboro, the franchise of the company, and a first mortgage of $20,000 per mile on each mile of main track and side track. He agrees to begin the real work of construction by January 1, 1889, and the preliminaries at once. He is to complete the road into the city of Owensboro within 3 years, in order to secure the $75,000 subsidy, and is to furnish the best rolling stock and materials to be used in its construction, and a large bond was given to insure the fulfillment of his contract.

Chowan & Southern R. R.—The grading of the first 73 miles of the Chowan & Southern Railroad was let Sept. 1st to Harper, Bruce & Co., and is to be completed by May 1st, 1889. The contractors have already begun operations, and it is expected the work will be under full headway in a short time.

Dayton & Faunsdale.—

DAYTON, Ala., Aug. 30, 1888.

EDITOR ENGINEERING NEWS:

The Dayton & Faunsdale Railroad was chartered July 6, and will be 8¼ miles in length. Work is light. Max. grades are 1 per cent. and the line is comparatively straight. The road is projected to develop the country and will have for its principal freight, cotton, cotton seed, merchandise, etc. Deeds to the right of way and about $20,000 in local aid have been secured; and negotiations for additional capital are in progress. The road is located and grading contracts will be let Sept. 11. S. D. BROWN, Mobile, Ala., is Chief Engineer, and H. W. MORGAN is Secretary. R. W. PRICE, *President.*

Atlantic, Tennessee & Western.—The franchise for this road has been sold to JOHN M. BAILEY, of Bristol, Tenn. The line is projected from Carter's Station, on the East Tenn., Va. & Ga. R. R., across eastern Tennessee to Asheville, N. C. Dr. BAILEY will consolidate the enterprise with his South Atlantic & Ohio Railroad, now well advanced toward completion from Bristol, Tenn., to the Breaks of Sandy.

Chattanooga, Hiwassee & Southern.—A $50,000 subscription has been voted this company by one of the North Carolina counties through which it has been surveyed.

Helena, Tupelo & Decatur.—A surveying corps has begun work on this Mississippi line, projected from Glendale, Miss., to Decatur, Ala. A. K. ROBINSON is Chief Engineers.

Bowling Green, Hartford & Ohio River.—This company has organized at Calhoun, Ky., to build a railroad from Bowling Green *via.* Morgantown, Hartford and Calhoun to a point opposite Evansville, Ind. G. P CARY, of Calhoun, is interested.

THE NORTHWEST.

Existing Roads.

St. Paul & Dulnth.—President R. S. HAYES has confirmed the report that the company will refuse to take part in the proposed combination of the Chicago lines to raise rates from the East, and will continue to act independently. The extensive improvements begun by President FISHER are to be pushed forward. Grades are to be reduced all along the line and a double track built from Minneapolis to White Bear. A large number of new iron bridges are to be put in at important points.

Chicago, Rock Island & Pacific.—In the test case, of this company *vs.* the Iowa State Railway Commission, Judge FAIRALL has denied the motion to vacate the existing injunction by which the Commissioners are restrained from enforcing their arbitrary tariff of freight rates.

Northern Pacific.—The contract made by Premier GREENWAY, representing the Provincial Government of of Manitoba, with the Northern Pacific was ratified by the Provincial Legislature on Aug. 31 by a vote of 27 to 10. The opposition to the contract and the movement in favor of accepting instead the proposition of the St. Paul, Minneapolis & Manitoba, was confined principally to the Winnipeg members.

St. Paul, Minneapolis & Manitoba.—Work is progressing rapidly on the Eastern Railway of Minnesota and it will be open for traffic before the end of this month. There are but 12 miles of track still to lay, the entire length of the line from Hinckley to West Superior being 69 miles. Half the line has been ballasted. The road is laid with 75-lb. steel rails; has max. grades of 21 ft. per mile and max. curves of 3°. At West Superior, the company owns 250 acres of land for terminals. It has already one elevator with a capacity of 1,800,000 bushels and is building another with 1,500,000 bushels capacity. The line will be of great benefit to the Manitoba system.

Duluth, Red Wing & Southern.—This company has five engineering parties now in the field, and is making further additions.

New Projects and Surveys.

Wisconsin Midland.—It is stated that the projectors of this enterprise are still confident of its ultimate success, and hope to begin construction during the present month.

Columbia & Northwestern.—This road is projected from Columbia to Milnor, Dak.

Beatrice, Nebraska City & Northwestern.—This company has filed a charter in Nebraska with a capital stock of $2,000,000. The projectors are D. P. ROLFE, ROBERT LORTON and W. A. COTTON.

Eau Claire, Mississippi River & Lake Superior.—It is stated that FREDERICK WEYERHAUSER, a wealthy lumber operator of Chippewa Falls, Wis., has interested himself in this Wisconsin enterprise, and will render efficient aid in furthering its construction. Surveys have been made from Eau Claire to the southern terminus, and it is hoped to build a part of the line between Eau Claire and Independence this year.

THE SOUTHWEST.

Existing Roads.

San Antonio & Aransas Pass.—The locating survey has been completed for the extension from Comfort to Fredericksburgh, Tex.

Wabash Western.—The general offices of this company have been removed from the Equitable Building to the building at the corner of Sixth and Olive Streets, St. Louis, Mo.

Texas Trunk.—This company has issued bonds to the amount of $1,000,000 to pay for extensions and improvements.

Denver, Texas & Ft. Worth.—Citizens of Dallas, Tex., are elated over the report that the extension of this road from Ft. Worth to Dallas will shortly be undertaken.

Missouri Pacific.—It is reported that the construction of a union station at St. Louis, has been decided upon.

New Projects and Surveys.

Brazoria, Caney & West Texas.—This company has filed its charter in Texas, and proposes to build a railroad from Brazoria to a point on Metagorda Bay, about 25 miles distant. B. T. MASTERSON, of Galveston, J. G. SMITH, of Brazoria, and others, are interested.

Harold, Garden City & Southwestern.—This company has been chartered in Kansas to build a railway from Harold *via* Garden City to the State line. W. N. DILLEY, of Harold, C. E. GALLAGHER, of Dodge City, L. T. NELSON, of Garden City, and others are interested.

Chicago, Hannibal & Springfield.—A press report from Centralia, Mo., quotes Mr. FUDGE, the attorney of this company, as denying the report that the enterprise had been abandoned. He also stated that the project, whtch was at first backed by the Chicago, Burlington & Quincy, has now been strengthened by the placing of heavy loans in Europe, and also by the coöperation and aid of the Santa Fé managers and that construction will begin this fall. The route which has been adopted is from Hannibal, *via* Perry, in Ralls county, and Centralia and Columbia, in Boone County, crossing the Missouri river at Wolf's Point.

ROCKY MOUNTAIN & PACIFIC.

Existing Roads.

Seattle, Lake Shore & Eastern.—The engineers surveying the Seattle & West Coast railway to the International boundary met the Canadian Pacific engineers at that point this week and located the junction point.—— Ryan & McDonald, who took the contract for 225 miles of the road, are reported to have made arrangements with the railroad company for release from their contract, the work being continued by the sub-contractors.——Tracklaying has begun on the connection with the Northern Pacific tracks at Spokane Falls.

Colorado Midland.—A party of surveyors are working west of New Castle, Col., the present end of the grade, and will probably locate a line down the river to Grand Junction to connect with the Denver & Rio Grande Western. It is thought that the Denver & Rio Grande will take the same route for its western extension.— Tracklaying is to be pushed at once on the extension to New Castle from the present end of track.

New Projects and Surveys.

Ballona & Santa Monica.—Surveys have been made for a railway between these towns in southern California. JAS. CAMPBELL, of Los Angeles, is interested.

Proposals Open.

Sewer.—Brick sewer, 1,300 ft. long, 4 ft. diameter, 14 to 30 ft. deep. Plans and specifications at the office of the City Clerk. J. HARVEY BELL, Mayor, Yonkers, N. Y. September 10.

Sewers.—A. C. BOTKIN, City Clerk, Helena, Mont. September 10.

Sewers and Paving.—Cobblestone paving; stone culvert; 24-in. brick sewer; 18 and 24-in. tile sewers. H. W. BANNISTER, City Clerk, Syracuse, N. Y. September 10.

Dredging.—About 23,000 cu. yds. at the Overslaugh, and 7,000 cu. yds. at Nine Mile Tree. JAMES SHANAHAN, Superintendent of Public Works, Albany, N. Y. September 11.

Bridge.—Wagon bridge across the Snoqualmie river; one span of 260 ft. or two of 135 ft.; 16 ft. wide. LYMAN WOOD, County Commissioner, Seattle, Wash. Ty. September 12.

Bridge.—Iron highway bridge and abutments, 80 ft. span, across the Onisquatha creek, near South Bethlehem station, West Shore R. R. WM. H. SLINGERLAND & SON, engineers. JOSEPH OLIVER, Commissioner of Highways (Bethlehem), care of SLINGERLAND & SON, 71 State St., Albany, N. Y. September 12.

Street Work, Gravel and Rock.—Grading and rocking streets with rock 18 ft. wide and 1 ft. deep; also for 1,000 cu. yds. of hard rock and 100 cars of gravel; also for quarrying rock. N. B. MURFF, Comptroller, Shreveport, La. September 13.

Sewer.—W. P. RICE, City Engineer, Cleveland, O. September 13.

Railway.—Grading from Dayton to Faunsdale, 8¼ miles. R. W. RICE, President, Dayton & Faunsdale Ry. Co., Dayton, Ala. September 13.

Sewers.—Three sections of district trunk sewer; 8 to 8-in. vitrified stoneware pipe. Engineer, WM. H. WORTHEN, M. Am. Soc. C. E., 63 Bleecker St., New York. THE COMMITTEE ON WATER AND SEWERS, Mount Vernon, N. Y. September 14.

Breakwater.—About 350 lin. ft. of superstructure on the east breakwater at Cleveland. Major L. COOPER OVERMAN, U. S. Engineer Office, Cleveland, O. September 14.

Sewer Pipe.—Vitrified, salt-glazed, double strength, socket, sewer pipe, according to specifications in the office of G. N. MILLER, Superintendent of Sewers; 6,160 lin. ft. of 9-in., 7,210 ft. of 12-in., 3,020 ft. of 15-in., 6,720 ft. of 18-in., 7,710 ft. of 21-in., 7,180 ft. of 24-in.; 10 per cent to be provided a 6-in. Y branch for house connections; delivered F. O. B. cars at Helena. A. C. BOTKIN, City Clerk, Helena, Mont. September 15.

Street Work.—Improvement of the Winton road. F. RAINE, County Auditor, Cincinnati, O. September 15.

Street Work.—Excavation, paving, curbing, etc. MARTIN FINCK, Clerk, Board of Public Works, Jersey City, N. J. September 17.

Buildings.—Life-saving station and boat-house at Oak island, mouth of Cape Fear river, North Carolina. W. D. O'CONNOR, Acting General Superintendent, U. S. Life-saving Service, Treasury Department, Washington, D. C. September 18.

Pumping Engine.—One compound, duplex pumping engine, with a daily capacity of not less than 1,500,000 galls. J. B. THOMAS, National Military Home, Dayton, O. September 18.

Breakwater.—Furnishing and placing stone in the gap at the Delaware breakwater. Lieut. Col. HENRY M. ROBERT, U. S. Engineer Office, Philadelphia, Pa. September 25.

Dredging.—In the Schuylkill river. Lieut. Col. HENRY M. ROBERT, U. S. Engineer Office, Philadelphia, Pa. September 25.

Dredging.—At David's island, Willett's Point and Fort Schuyler, New York Harbor. Lieut. Col. J. G. CHANDLER, U. S. Army Building, New York City. September 25.

Building.—Superstructure and interior work for U. S. public building at Binghamton, N. Y. WILL A. FRERET, Supervising Architect, Treasury Department, Washington, D. C. September 26.

Bridge.—Wooden bridge across Octoraro creek; combined or separate bids for masonry and superstructure. Engineer, S. C. SLAYMAKER, of Lancaster, Pa. THE BOARD OF COUNTY COMMISSIONERS, Lancaster, Pa. September 27.

Bridge.—Iron or wooden bridge across Mill creek; combined or separate bids for masonry and superstructure. THE BOARD OF COUNTY COMMISSIONERS, Lancaster, Pa. September 29.

Viaduct.—Iron and stone viaduct. THE HAWK ST. VIADUCT COMMISSIONERS, Albany, N. Y. September 29.

Water-Work or Artesian Well.—Propositions wanted to sink an artesian well or put in water-works. ALEX. T. BUTLER, Douglas, Wyo. Ter.

Contracting.

New Croton Aqueduct.—At the meeting of the Aqueduct Commissioners on Sept. 5, the following proposals were received for ten 48-in. stop-cock valves: Caldwell, Wilcox & Co., Newburg, N. Y., $1,290; John Fox, New York, $1,575; J. Johnson, New York, $1,948; Galvin Brass & Iron Works, Detroit, Mich., $2,500.—A bid for the construction of the iron-lined aqueduct near Shaft No. 30 was received from Rogers, Shanley & Co.—The Chief Engineer was instructed to prepare plans and specifications for a connection of the old aqueduct and the new gate house at 135th St., by a masonry conduit of the same size as the old aqueduct; also for the furnishing and laying of four 48-in. mains from the new to the old gate house.

Mobile Harbor.—Major A. N. DAMRELL, U. S. Engineers, in charge of the work on Mobile harbor and Biloxi bay, is prepared to advertise for bids for the work. That on the ship channel is an important one to Mobile, and it is hoped that good practical men may obtain the contract so as to lose as little time as possible in getting to work. It is trusted the appropriation may be sufficient to give 19 ft. in depth for the channel, or about 3 ft. more than at present. This would of itself largely extend the shipping of this port.

Viaduct Approach.—At Chicago, Ill., the Commissioner of Public Works has received the following proposals for the erection of the Fifth Ave. approach to the 12th t. viaduct: Chicago Forge & Bolt Co., $40,950; A Gottlieb & Co., Chicago, $43,900; Riter & Conley, Pittsburg, Pa., $45,270; Clark, Raffen & Co., $48,789.

Reservoir.—At Lancaster, Pa., the Water Commissioners awarded to JOHN F. STAUFFER the contract for cleaning the west reservoir, which has a capacity of 3,000,000 galls., for $190. Two other bids were received, both higher and both informal. The work has been completed.

Pumping Machinery.—At Allegheny, Pa., the old pumping machinery at the River Ave. pumping station of the water-works has been sold to Wilson, Snyder & Co., of Pittsburg, Pa., for $42,000. The machinery was described on page 175.

Sewage Pumping Plant.—*Providence, R. I.*—The Joint Special Committee appointed to purchase land for the sewerage works at Sassafras Point has been authorized and directed to contract for the building of the pumping works, engines, precipitation tanks and conduits in accordance with the plans and specifications prepared by City Engineer S. M. GRAY, upon the land now owned by the city at Sassafras Point and Field's Point.

Trunk Sewers.—*Mount Vernon, N. Y.*—The Board of Trustees of the village of Mount Vernon, N. Y., will receive proposals until 8 P. M., of Sept. 14, for constructing Sections Nos. 1, 2, and 3 of district trunk sewer. The sewers are to be of 8 to 18-in. vitrified stoneware pipe. Persons proposing to bid must obtain a printed copy of the proposals, specifications, contract and bond, and examine the plans, drawings and profiles, now ready, and be guided thereby as to the nature of the work. Proposals must be made for each section separately and the contracts will be awarded separately. WM. E. WORTHEN, 63 Bleecker St., New York, is the Engineer. DAVID QUACKINBUSH, Village President; DAVID C. CURTIS, Chairman of Committee on Water and Sewers; JAMES H JENKINS, Village Clerk. Proposals must be addressed to the "The Committee on Water and Sewers."

Retaining Walls.—*Providence, R. I.*—Proposals for excavating soft material, refilling with sand or gravel, and building walls for the extension of the Woonasquatucket and Moshassuck rivers through the Cove basin, have been received by the Joint Special Committee on Railroad Terminal Facilities. The plans and specifications were prepared by S. M. GRAY, City Engineer. The following are the quantities and the prices of the engineer's estimate:—A, 124,900 cu. yds. of excavation, 40 cts. per cu. yd., $49,960; B, 83,950 cu. yds. of sand or gravel filling, 50 cts. per cu. yd., $41,975; C, 1,528 cu. yds. of riprap, $2.50 per cu. yd., $3,820; D, 210 cu. yds. of concrete, $10 per cu. yd., $2,100; E, 800 spruce piles, $6 each, $4,800; F, 18,250 ft. B. M. of spruce lumber capping, $35 per 1,000 ft. B. M., $638.75 G, 8,460 cu. yds. of rubble masonry in cement, $10 per cu. yd., $84,600; H, 2,825 cu. yds. of dry rubble masonry, $10 per cu. yd., $28,250; I, 3,333 lin. ft. of coping set, and J, 2,603 lin. ft. of railing, 50 cts. per lin. ft., $1,666.50; 10 per cent., $21,781.03; total, $239,591.28.

The proposals were as follows:—Jas. J. Newman, Providence, R. I.; A, 30 cts., $37,470; B, 60 cts., $50,370; C, $2, $4,584; D, $7, $1,470; E, $4.75, $3,800; F, $35, $638.75; G, $7, $59,220; H, $12, $33,900; I, 35 cts., $1,166.55, J, 50 cts., $1,301.50; total, $193,920.80.

R. J. Malone and Jno. T. Moore, New York City and Newburg, N. Y.; A, 40 cts., $49,960; B, 59 cts., $49,530.50; C, $2.40, $3,667.20; D, $6, $1,260; E, $5, $4,000; F, $25, $456.25; G, $6.40, $54,144, H, $11, $31,075; I, 60 cts., $1,999.80; J, 75 cts., $1,952.25; total, $198,045.

Boynton Bros., Providence and Boston; A, 60 cts., $74,940; B, 60 cts., $50,370; C, $2, $3,056; D, $7, $1,470; E, $3, $2,400; F, $40, $730; G, $6, $50,760; H, $8, $22,600; I, 70 cts., $2,333.10; J, 50 cts., $1,301.50; total, $209,960.60.

Atlantic Dredging Co., New York City; A, 39 cts., $48,711; B, 60 cts., $50,370; C, $5, $7,640; D, $6.50, $1,365; E, $4.50, $3,600; F, $30, $547.50; G, $7.25, $61,935; H, $12, $33,900; I, 50 cts., $1,666.50; J, $1, $2,603; total, $211,738.

Samuel R. Bullock, New York City; A, 38 cts., $47,462; B, 58 cts., $48,691; C, $2, $3,056; D, $6, $1,260; E, $5, $4,000 F, $40, $730; G, $8.50, $71,910; H, $12, $33,900. I, 40 cts. $1,333.20; J, $1.05, $2,733.15; total, $215,075.35.

Franklin A. Snow, Providence, R. I.; A, 44 cts., $54,956; B, 60 cts., $50,370; C, $1.25, $1,910; D, $7, $1,470; E, $7, $5,600; F, $30, $547; G, $5.50, $46,530; H, $16.50, $46,612.50; I, $1.25, $4,166.25; J, $1.75, $4,555.25; total, $216, 717.50.

Chas. F. Mairs, New York City; A, 42 cts., $52,458; B, 88 cts., $73,876; C, $1.65, $2,521. 20; D, $5.50, $1,155; E, $9.90 $7,920; F, $30, $547; G, $5.75, $48,645; H, $14, $39,550; I, $1.25, $4,166.25; J, 80 cts., $2,082.40; total, $232,921.35.

Shaw & Whittlesey, Providence, R. I.; A, 46¼ cts., $57-766.25; B, 80 cts., $67,160; C, $3, $4,584; D, $10, $2,100; E, $3.75, $3,000; F, $40, $730; G, $7.50, $63,450; H, $13, $36,725; I, 60 cts., $1,999.80; J, 80 cts., $2,082.40; total, $239,597.45.

Jas. Ross, Ipswich, Mass., Thos. A. Rome, Newton; Mass., and F. H. Blaisdell, Lynn, Mass.; A, 70 cts., $87,430; B, 70 cts., $58,765; C, $3, $4,584; D, $10, $2,100; E, $6 $4,800; F, $60, $1,095; G, $7, $59,220; H, $11, $31,075; I 60 cts., $1,999.80; J, 50 cts., $1,301.50; total, $252,370.30.

Edward L. Suffern, Plainfield, N, J.; A, 75 cts., $93,675; B, 92 cts., $77,234; C, $4, $6,112; D, $6, $1,260; E, $10, $8,000; F, $35, $638; G, $8.50, $71,910; H, $15, $42,375; I, $1.80, $5,999.40; J, $1.50, $3,904.50; total, $311,108.65.

The contract has been awarded to James J. Newman, at $193,920.80. The committee has as yet taken no action in relation to filling the Cove Basin for the reason that in the opinion of the City Engineer it would not be desirable to begin the work of filling until such time as the retaining walls approach completion. The estimate of cost for filling the Cove Basin, as made by the City Engineer, will bring the entire cost of building walls and filling the Cove largely within the appropriation made by the City Council for completing this work. The channel for the Woonasquatucket river is to be 100 ft. wide, and for the Moshassuck river 51 ft. wide, or a total of 18 ft. in width more than the outlets of the two rivers.

Bridge.—The following proposals were received by the Sheboygan & Calumet Plank Road Co., of Sheboygan, Wis., for furnishing the material and doing the work of building a bridge across the Sheboygan river, about ½ mile north of Millhome, on the Sheboygan & Calumet plank road. The proposals were to be for an iron bridge, 1 span, 80 ft. long, 16 ft. wide, with tubular iron or stone piers; the same, combination, with either the above piers; also iron or combination bridge, two spans, of 40 ft. each, with center and end piers of either material; or a wooden bridge with stone or crib piers. Bidders were required to submit their own plans and specifications. Pittsburg Bridge Co., Pittsburg, Pa., one span of 80 ft., with cylinder piers, $1,963; two spans of 50 ft., with iron center and end piers, $2,033; two spans of 50 ft., with iron center pier, $1,800. Milwaukee Bridge Co., Milwaukee, Wis.; one span of 80 ft., with iron piers, $1,950; two spans of 50 ft., with iron center and end piers, $2,010. Champion Bridge Co., Wilmington, O.; one span of 80 ft., with iron end piers, $1,974; two spans of 50 ft. each, with iron center and end piers, $2,074; two spans of 50 ft. with iron center pier, $1,775. Wisconsin Bridge & Iron Works, Milwaukee, Wis.; one span of 80 ft., with cylinder piers, $1,698; one span of 80 ft., without substructure, $1,400; two spans of 50 ft., with iron center and end piers, $1,835; two spans of 50 ft., with iron center pier, $1,600; two stone abutments, if required, $600. F. Maurer, of Millhome, Wis.; one wooden bridge of 80 ft. span, $1,100. The contract was awarded to the Wisconsin Bridge & Iron Works.

Bridge Contracts.—*Belleville, N. J.*—The contract for the new bridge at North Belleville, has been awarded by the Boards of Essex and Bergen counties as follows: masonry and piling, A. R. Morrison, $15,540; iron work, Smith Bridge Co., Toledo, O., $10,175. The total expense is limited to $26,000, half to be paid by Essex Co. The work will occupy about 4 or 5 months.

Baltimore, Md.—The County Commissioners have awarded the contract for building a new bridge over the Little Patuxent river, on the old Washington road, in the sixth district, to the Wrought Iron Bridge Co., of Canton, O., for $2,195. The masonry work for the abutments of the bridge will be in charge of C. F. RAPPANIER, of Ellicott City. The contractors have 3 months in which to complete the work. The bridge will have but one span, which will be 105 ft. long.

Wellsburg, W. Va.—The Massillon Bridge Co., of Massillon, O., has the contract for a bridge to cost $3,408. The Champion Bridge Co., of Wilmington, O., has the contract for a bridge to cost $1,898.

Fetterman, W. Va.—The Smith Bridge Co., of Toledo, O., has the contract for an iron bridge to cost about $5,000.

Parkersburg, W. Va.—The following were the proposals received by the County Commissioners for the new iron bridge over the Little Kanawha river: Wrought Iron Bridge Co., Canton, O., $24,820; King Iron Bridge & Mfg. Co., Cleveland, O., $25,600; Penn Bridge Co., Beaver Falls, Pa., $25,690; Smith Bridge Co., Toledo, O., (iron) $25,900, (steel) $27,300, (different specifications) $28,500; Mt. Vernon Bridge Co., Mt. Vernon, O., $25,982; R. Meredith & Son, Marietta, O., $26,100; Columbia Bridge Co., Dayton, O., $26,100; Pittsburg Bridge Co., Pittsburg, Pa., $26,250; E. B. Henderson & Son, Marietta, O., $26,300; Variety Iron Works, Cleveland, O., $27,000; Groton Bridge Co., Groton, N. Y., $27,000; Lomas & Frye Bridge Co., Cincinnati, O., $27,392; Dean & Westbrook, New York, $27,393; Champion Bridge Co., Wilmington, O., $28,000; Massillon Bridge Co., (iron) $29,000, (steel) $32,000. The contract was awarded to the Wrought Iron Bridge Co. The bridge will be a Whipple double intersection truss, 296 ft. 4½ ins. long, with a 20-ft. roadway and two 5 ft. sidewalks. Mr. FICKINGER is engineer for the County Commissioners.

Kansas City, Mo.—The contract for repairing the old southern bridge has been awarded to the Kansas City Bridge & Iron Co. at $26,600.

Lincoln, Neb.—The County Commissioners have awarded contracts for iron bridges, to the Ottumwa Bridge Co., of Ottumwa, Ia., and for wooden bridges to T. J. Grant, of Denver, Col.

San Bernardino, Cal.—The County Supervisors have awarded bridge contracts to A. McCrary & Son, and the San Francisco Bridge Co., of San Francisco, Cal.

St. Paul's Bay, Que., Canada.—The contract for building the bridge at St. Paul's Bay has been awarded by the Federal Government to Messrs. Cimon and Tremblay, of that place.

Bridges and Canals.

Stone Arch Bridge.—The St. Paul, Minneapolis & Manitabo Ry. is putting in a stone arch bridge at Sauk Center, Minn.

Bridge Works.—It is exported that R. W. CURTIS, of Decatur, Ala., will form a company to establish extensive bridge works at Chattanooga, Tenn.

Nebraska City, Neb.—The new steel bridge built for the Chicago, Burlington & Quincy R. R., was formally opened Aug. 30 with appropriate ceremonies. The cost of the bridge was $1,500,000.

Drainage Canals.—The Atlantic & Gulf Coast Canal Co., of Tallahassee, Fla., and the Okeechobee Land Co., have made a new contract with the State for draining swamp lands in south Florida.

The Quebec Bridge.—According to reports from Quebec, President Cleveland's retaliation policy has given an unexpected stimulus to the Quebec bridge project. The directors of the bridge company held a meeting Aug. 28 and decided to proceed at once with the necessary surveys for the proposed bridge across the St. Lawrence, which is the last link needed to complete the chain of transcontinental communication *via* the Intercolonial and Canadian Pacific wholly on Canadian soil.

Chambly Canal.—The Department of Railways and Canals, of Canada, has made considerable improvements at this canal. During the fiscal year ending June 30, four old locks, that had become an obstruction to the working of the canal, have been removed and first class new ones built in their place. The canal in the vicinity of St. John's, Que., has been deepened and altogether, during the year, the sum of $80,000 has been expended by the Department on the canal.

The Jeffersonville Bridge.—The Board of U. S. Engineers appointed to examine and report upon the plans of the proposed bridge across the Ohio river at Louisville, Ky., submitted by the Louisville & Jeffersonville Bridge Co., have presented their report and recommended as follows: "*First*; That the proposed bridge be moved further up the river, to some point at or above Wall St., in Jeffersonville, and that it be built with a channel span near the Indiana shore, of 500 ft. in the clear.— *Second*; If the present location of the bridge be accepted, the Board, while strongly disapproving of it, recommends that there be a span at least 650 ft. wide in the clear near the island shore, with the Kentucky pier at low water mark on the island." The proposed location of the bridge has therefore been disapproved by the Chief of Engineers.

Bridges. — ***Vermont.*** — Brattleboro. The scheme to bridge the Connecticut river opposite the Waite farm is again revived, and Chesterfield people are credited with a proposition to contribute $10,000 toward the project, provided Brattleboro will raise the balance.

Massachusetts.—Wareham. The Old Colony R. R. has put in a new iron bridge.——Orange. The old wooden bridge over the railway tracks at South Main St., will be replaced by an iron bridge, 15 ft. wider and 3 ft. higher. The work is divided between the railway company and the city.

Connecticut. — Canton. A new iron bridge is being built across the Farmington river in Collinsville.——The Connecticut River R. R. Co. has finished four of the five iron bridges which they planned in the spring for a season's work, and has begun work on the remaining one, just north of the Chicopee Junction depot. The others have been built over the upper canal at Holyoke, across the river at Mt. Tom, another at Northampton, and the fourth over the upper stream at Chicopee.

New York.—Port Chester. The New York, New Haven & Hartford R. R. is building a 6-track bridge.——Wayville. The highway bridge owned by the Fitchburg R. R. has been condemned and a new one will be built.——Medusa. The town bonds for the new iron bridge have been issued and disposed of.——Middleville. Work is in progress on the new iron bridge across the West Canada creek.——Oneonta. The main span of the new iron bridge over the Susquehanna will be 170 ft. The piers will soon be ready for the iron work now in preparation. Another river bridge will soon be needed at East end.

New Jersey.—Newark. A new bridge will be built over the Passaic to Kearny and Harrison ; also one over the Mill brook.

Pennsylvania.—Lancaster. Col. SLAYMAKER has prepared plans for a wooden bridge over Octoraro creek. Proposals will be received till Sept. 27.——Pittsburg. The 30th St. bridge to Allegheny will be opened next week. There are two spans of 229 ft. and one of 305 ft.

Maryland.—Baltimore. A bridge across Jones Falls is proposed and estimates have been made for the City Commissioner. The Cedar Ave. bridge is under construction; it will be an arch bridge of 300 ft. span, with a 30-ft. roadway and two 6 ft. sidewalks; the cost is estimated at $58,000. CHARLES H. LATROBE, Engineer and Superintendent of Parks, is the engineer.

Tennessee.—Normandy. The Nashville, Chattanooga & St. Louis R. R. Co. will build a new bridge over Duck river.

Florida.—Palatka. The Palatka Bridge Co. has been incorporated by R. H. MASON, J. P. KELLY and J. P. PARROT, to build a bridge across the St. John's river. Capital stock, $100,000. The office will be at Jacksonville.

Alabama.—Eufaula. The Georgia Central R. R. Co. will build an iron bridge across the Chattahoochee.——Birmingham. J. D. Avery will build an iron bridge over the Cahaba river.——Florence. The Memphis & Charleston R. R. Co. will build a new channel span and draw for its bridge across the Tennessee river.

Mississippi.—Natchez. A local company is to be organized to build a bridge over the Mississippi, Address W. S. MARTIN or S. C. SHIELDS.

Ohio.—Dayton. The Montgomery County Commissioners have sold $20,000 bonds for the Webster St. bridge and $20,000 for the Findlay St. bridge.——Cleveland. Work is being pushed on the new Seneca St. bridge, and it is expected to have it completed by December.

Indiana.—Indianapolis. The County Commissioners will probably have an iron bridge built over the run at Auburn St.

Michigan.—Manistee. The bridge and trestle for the Manistee & Northeastern Ry. is nearly completed.——Detroit. The Michigan Central Ry. will lower the Jefferson St. bridge 1 ft. and build a new bridge over its tracks at W. Fort St.

Illinois.—Carlyle. A $3,000 iron bridge is being built over Shoal creek about 1¼ miles south of Germantown. The citizens of Germantown are paying for it and they are going to hold a grand picnic and barbecue Sept. 12, the proceeds of which are to be applied to the bridge fund.

Wisconsin.—La Crosse. Messrs. Horton & O'Neil, who built the high wagon bridge at Dubuque, Ia., which was completed last year have made a proposition to build a similar bridge across the Mississippi at La Crosse. Surveys have been made and the estimated cost for the bridge and a road across the La Crescent marsh is $200,000. The movers in the scheme ask a bonus from the city of $80,000.

Minnesota.—Minneapolis. Engineer CAPPELEN states that owing to the non-arrival of the iron required the superstructure for the bridge across the railroad tracks on Lyndale Ave. will not be completed before the end of September. The Franklin Ave. bridge will soon be ready for the paving.——St. Paul. President R. S. HAYES, of the St. Paul & Duluth Ry., has had specifications and contracts prepared for new iron bridges over the principal streams on the line; the Snake, Grindstone, Kettle and St. Louis rivers.——Winona. The Winona & Southwestern Ry. Co. has been authorized to build a combined railway and highway bridge across the Mississippi.

Kansas.—Leavenworth. The special committee on the 2nd St. bridge over Three-Mile creek has reported in favor of constructing an iron deck bridge, 66 ft. long, with roadway 30 ft. wide and two 5 ft. sidewalks, supported on stone abutments; one of said stone abutments to rest on the stone ledge on the south side of said creek and the other abutment in the bed of the creek. The City Engineer presented plans, specifications and estimates of cost of such a bridge at the Council Meeting Sept. 5, and proposals will soon be advertised.

Missouri.—Kansas City. It is reported that W. E. WINNER has made arrangements for the construction of the railway, highway and dummy line bridge across the Missouri which was authorized by the last session of Congress. The cost has been estimated at $600,000.

Colorado.—New Castle.—A bridge will probably be built across Grand river by the County Commissioners.

Oregon.—Portland. The Morrison St. Bridge Co. has fitted new and larger wheels to the turntable of the draw. It is proposed to put in a steam turning gear.

California.—San Francisco. Asst. Eng. UHLIG, of the Harbor Commission, has prepared plans for a bridge across East St. from the end of Sacramento St. to the ferry. It will be 90 ft. span.——Santa Barbara. The City Trustees will order a vote on the issue of bonds for $25,000 for bridges.——Sacramento. The Sacramento County Commissioners and the San Joaquin Supervisors will build a bridge across the Mokelumne river at Benson's Ferry.

Texas.—El Paso. The Senate Committee, at Washington, D. C., has reported a bill to authorize the construction of a highway and street railway bridge across the Rio Grande between El Paso and Paso del Norte.——Ballinger. Work is progressing on the new railway bridge.

Canada—Coteau Landing, Que. Messrs. MCMAHON, BEGG and SHEA, of St. Catherines, Ont., have closed a contract with the Canada Atlantic Railway Co., for the construction of a bridge over the St. Lawrence river at Coteau Landing. The contract price aggregates $560,000.

WATER.

Rochester, N. Y.—The Holly Steam Heating Co. is at work on the apparatus for the city of Rochester, where a building is now in course of erection on Aqueduct St.

Lincoln, Neb.—A water supply is needed for the State Fair, held by the Nebraska Exposition Co., and the Board of Public Works has been instructed to enter into a contract with Joseph Burns, the well sinking contractor, for wells at the fair grounds.

Richmond, Va.—The sub-committee which recently visited Washington, Baltimore, Philadelphia and New York to inquire into the best means of increasing the capacity of the gas works, has made its report, in which it states that unless the city is ready to spend a very large sum on the present gas works, it would recommend the erection of a water-gas plant with a daily capacity of 500,000 cu. ft. The Committee on Light has decided that coal-gas, instead of water-gas, shall be used in increasing the capacity of the gas works, and a resolution was adopted instructing the Chairman and the Superintendent to advertise for proposals for erecting new benches, etc.

Natural Gas at Sparta, Ill.—The City Council and the owners of the gas well No. 1, have not yet agreed as to the terms of franchise in the matter of furnishing light and fuel for city consumption. The Council desires on the city's part protection against any monopoly that might result in a demand for exorbitant prices; on the other hand, the company wants a reasonable assurance that, when they have invested a large sum of money in piping the streets, the contract shall be such as to give promise of fair returns. Meantime, temporary piping supplies gas free for all who wish it.

Petersburg, Va.—A reservoir is being built to supply water to the Virginia Normal & Collegiate Institute.

Natural Gas.—The Philadelphia Natural Gas Co. is perfecting arrangements to build a 20-in. line from Grapeville to Murrayville, Pa., a distance of 7 miles. At the latter point the new line will connect with the regular system of the company.

Water Power.—At Gothenburg, Dawson Co., Neb., it is proposed to use the water from the Platte river for water power, by means of a canal 7¼ miles long, emptying into a reservoir 40 ft. above the town. The reservoir will cover an area of 80 to 100 acres.

Bloomington, Ill.—According to report the mayor still refuses to sign the contract with the Jenney Electric Co. unless the contract contains the clause permitting the Council to throw up the contract at the end of any year, but the company will not accept the contract if this clause is inserted. The mayor believes that the contract would not be legal without the clause, but the company does not wish to invest $80,000 with the chance of being ousted in a year or two.

Los Angeles, Cal.—F. T. NEWBERY, C. E., of San Francisco, has sent a communication to the Los Angeles Board of Trustees, offering to furnish plans for a sewer system to take the place of the proposed outfall sewer. He suggests separating the water from the sludge, using the former for irrigation, and either burning the sludge or making manure out of it. He claims that the cost would be much less than for a $300,000 outfall sewer.

Water Waste at Lincoln, Neb.—The Mayor has sent a communication to Water Commissioner LYMAN urging him to take some immediate steps towards reducing the excessive waste of water. Twice the necessary amount of water is being used, and even with the two pumps running night and day it is impossible to keep up a proper pressure. The works are pumping not less than 2,500,000 galls. per day, which amount would be ample for all legitimate purposes. The Water Board has adopted stringent rules, but little attention is paid to them. Citizens who persist in letting the water run from faucets and closets will be fined or have their supply shut off. Each consumer is now to be supplied with a copy of the rules and regulations, and a system of night inspection will be started in order to detect and locate the points where water is being wasted.

Electric Light in St. Paul, Minn.—The St. Paul Gas Light Co. has been made the defendant in an important suit commenced by the United States Electric Lighting Co. and the St. Paul Electric Light & Power Co. "In 1886 the St. Paul Gas Light Co. entered into a contract with the United States Electric Lighting Co. and the St. Paul Electric Light & Power Co. by which the former was given the privilege to use certain patented machinery for electric lighting in St. Paul. The defendant is now about to discard the system sold to it by the plaintiffs and put in what is known as the Westinghouse alternating system. The plaintiffs propose to hold the gas light company to its contract and compel it to either continue using their system or discontinue the incandescent business altogether. They therefore ask the court to issue an injunction restraining the defendant from using in St. Paul any system of incandescent lighting other than that supplied by the United States Electric Lighting Co."

Greenville, Tex.—Hon. W. G. PERKINS, the mayor, has received a communication from JOHN W. HARRISON, of St. Louis, one of a company proposing to build a system of water works here, to the effect that the company is only waiting the arrival of J. H. COOK, of Greenville, to sign the acceptance of the franchise, when the same will be filed with the city of Greenville; also that the waterworks company will proceed with the work of construction at once. The mutual acceptance of the proposition is virtually closed. The company is to make a lake 1 mile northwest of the city to hold 3,000,000 galls. of water; to furnish a steel stand-pipe 130 ft. high and 15 ft. in diameter; the system to supply 2,000,000 galls. of water daily; the engine and pump-house to be of brick. There is to be 1 mile of 10-in. pipe, 4 miles of 6-in. pipe, and enough smaller pipe to supply all parts of the city. Sixty hydrants are to be furnished for fire and other purposes, to be located by the City Council. The rate for water to private parties is not to exceed the lawful rate for Dallas and other Texas cities. The franchise fixes a maximum rate to be charged. The system is to cost about $85,000, is to be owned and operated by the company, and the city of Greenville is to pay an annual rental of $5,000. The company is composed of JOHN HARRISON, T. B. NICHOLS and THOMAS HOWARD, of St. Louis, and T. H. KING, J. H. COOK and J. D. LASSATER, of Greenville. Work must be begun within 60 days and be completed inside of 6 months.

Duluth, Minn.—"The City Council of Duluth, acting upon recommendation of Mayor SUTPHIN, has directed the City Attorney to bring suit to annul the charter of the Duluth Gas & Water Co., and to procure, if possible, an injunction preventing them from connecting the Superior Water-Works system with the pipes of the Duluth system. The charter of the company was granted in 1883 to run for 30 years, and the company has expended over $1,000,000 in mains and works. The cause of the Council's action is alleged general failure to supply the city with adequate reservoirs and pressure and with pure water, and failure in many other ways to live up to the provisions of the charter.—Detroit *Free Press.*

Helena, Mont.—The Helena Water Co. is extending its distribution system through the Grand Ave. addition, which will be a great improvement to the northern part of the city. The following resolution has been adopted by the City Council:—"That until the legal status of the question be decided by the court of last resort, the city use no more water for municipal and fire purposes from the pipes, mains and hydrants of the new or West Side Water Co. or the W. A. Chessman and Helena Water Co. and for the purpose of carrying into effect this resolution the city clerk is hereby directed to notify each of said companies and persons of the determination of the city council, and to direct the fire marshal and employés of the city that no further water is to be used from said companies' and persons' mains, and that they and each of them are directed not to use any of the hydrants belonging to either of said companies or persons."

Sewerage.—***Newport, R. I.***—The sewer tunnel is completed, and the sewerage work is nearly finished.

Syracuse, N. Y.—The Mayor is in favor of building a trunk sewer at Onondaga creek, which would cost about $300,000. It is proposed to get an appropriation through the Legislature for $300,000 or $400,000 for this work.

Philadelphia, Pa.—The Board of District Surveyors has approved plans for new sewers and extensions.

Americus, Ga.—A system of sewerage is contemplated and the mayor has been authorized by the council to have estimates made of the cost of a complete system.

Chicago, Ill.—Work is in progress on the assessments for the Parkside drainage system. The system will cost $14,600, and will free from all surface water the territory between Sixty-seventh and Seventy-fifth Streets, Cottage Grove Avenue, and the lake. Work on the Woodlawn Park drainage system, which is much more extensive, is being rapidly pushed, a large force of men being employed.

Springfield, Mo.—An ordinance has been introduced to authorize the issue of bonds for $150,000 for a sewerage system on the Waring plan. It is possible that only $75,000 will be voted for. A vote will be taken some time this month.

Rochester, Minn.—The city has accepted the proposition for a system of sewers and will issue bonds for $20,000 for the completion of the works.

Mitchell, Dak.—The City Council has engaged a firm of engineers of St. Paul, Minn., to prepare plans for the proposed system of sewerage.

Helena, Mont.—The $150,000 bonds for sewers have been sold to W. E. Cox, representing Boston capitalists, at 1 per cent. premium, or $151,500 for the entire issue. The Sewerage Committee has recommended that work be begun at once, that an outlet be made for Sewerage District No. 1 into the Ten Mile creek, and that a filtration farm of not less than 80 acres be procured as an outlet for District No. 2.

Fresno, Cal.—Landreth & Fitzgerald, Civil Engineers, of Schenectady, N. Y., and Henry Anderson, of San Francisco, have offered to submit plans for a sewerage system.

Water Works.—***Rhode Island.***—Jamestown. The Jamestown Water Co. will purchase an area of land upon which a large well, 6 or 7 ft. deep, will be dug; an ample supply of spring water is expected. The supply will be by gravity and pipes will be laid in the main streets and to the steamboat dock.

Massachusetts.—Great Barrington. The injunction to restrain the Great Barrington Water Co. from taking water from the Leavitt brook has been granted, with the provision that it will be removed if at any time the company finds it necessary to take the water to supply the demands of consumers. The application of the Berkshire Heights Water Co. for an injunction to restrain the former company from supplying water to patrons of the latter company was denied. There is some talk of taking a supply from Mansfield lake.

Ohio.—Cincinnati. The Board of Public Affairs has voted to pay half the expense (not to exceed $15,000) of the surveys for the new water-works; the money to be paid out of the water-works fund.

Virginia.—Covington. Water-works are to be built by a local company. Address E. M. NETTLETON.—— Abingdon. It is proposed to issue bonds for $20,000 for water-works and gas works.——Lexington. The contract made recently with the Glamorgan Pipe Foundry, of Lynchburg, calls for about 2¼ or 3 miles of 4 and 6-in. pipe, to be laid between the reservoir and Conner's spring. The contract is worth about $6,000.

West Virginia.—Huntington. Another test of the water-works has been made, with more satisfactory results than the former tests. W. W. CUNNINGHAM is the manager.

Tennessee.—Nashville. The engines for the new water-works are being erected and will be ready for use by November.

North Carolina.—Charlotte. The water-works are being extended at a cost of about $6,000.

Florida.—Tallahassee. A vote will be taken shortly on the proposition to issue bonds for $30,000 or $35,000 for a system of water-works. Plans and specifications have been prepared by H. S. DUVAL.

Michigan.—Grand Rapids. The Hydraulic Co. has its stand-pipe nearly completed. The water is of good quality and the pressure satisfactory.

Iowa.—Tipton. Water-works are to be built.——Burlington. The daily papers are full of letters from parties wishing to air their views on the water franchise and the water question in general.——West Liberty. A vote will be taken shortly on the proposition to bond the town for $10,000 for water-works.——Cedar Rapids. The second artesian well at the water-works is flowing at the rate of 300 galls. per minute, and the flow of the other well is not decreased. Another well will be sunk and the three wells will be connected directly with the pump so that the water will be drawn direct from the wells and the pumps be assisted by an equivalent to 14 lbs. pressure. This will give the city a supply of 1,250 galls. per day more than is needed.

Missouri.—Washington. The water company has completed the overflow wall between the reservoirs. It is of solid masonry, 40 ft. long, 5 ft. wide at the base, 12 ft. high, and 2 ft. wide at top. The company has also finished the excavations for the pump house, and the engines will be placed in a pit, about level with the river bed.

Kansas.—Olathe. The city will probably replace its present filter with one of different make.

Nebraska.—Lincoln. Contractor Joseph Burns is sinking 20 wells on the grounds of the State Fair, and has guaranteed a daily supply of 250,000 galls.——Valparaiso. Water-works are to be built at a cost of about $15,000.—— Central City. Water-works are to be built and $20,000 have been voted for the purpose.——North Bend. Water-works are to be built.

Colorado.—Glenwood Springs. The water-works will be opened with some ceremony. They represent an investment of $75,000. MASON W. MATHER is the engineer.

California.—Anderson. On Aug. 23 the Anderson Water Co. turned water into the mains from the reservoir.—San Bernardino. The City Engineer, A. H. KOEBIG, has made an estimate of the cost of a system of water pipes to supply the engines with water in case of fire, and finds that with cast-iron pipe it would cost $8,637; patent pressure pipe $6,828; No. 12 sheet iron pipe $4,232.

Texas.—Galveston. Work is now in progress on four of the driven wells. Pipe laying, and work on the foundations of the pumping station are also in progress. Well No. 4 is down 340 ft.

Canada.—Shelburne, Ont. The town has voted to appropriate $12,000 for water-works.——Vancouver, B. C. The pipe across the narrows at the entrance to the harbor was successfully laid Aug. 28, by the water-works company, ensuring an ample supply of fine water from Capilano river. The works are now well advanced and in a short time the complete system will be in operation throughout the city.

Special Reports of Water-Works Construction.

THE ENGINEERING NEWS MANUAL OF AMERICAN WATER-WORKS is now being compiled, and will be *indispensable* to every manufacturer, engineer and contractor in any way interested in Water-Works construction and maintenance, and will be of great value to Water-Works superintendents and projectors of new works.

Superintendents of water-works and water companies will wish to see correct and complete data concerning their Works in our MANUAL, and to ensure this they should send in reports *at once* upon the blanks which we have already sent to every Water-Works office in the United States and Canada. Many have delayed their report, and if the blanks we intended for them have been lost in the mail, or mislaid, we will send more upon request.

We *must* have a report from every public water supply system in North America, so those who reply to our inquiries at once will save a second inquiry. We also wish to know of *every* new Water-Works plant in process of construction, and of *every* new project in this line. We will send to any one desiring them, blanks upon which reports can be made.

Further details of the MANUAL will be advertised later. We abstract from our special reports for the MANUAL the following items of current interest:

BUFFALO, N. Y., Aug. 30, 1888.

EDITOR ENGINEERING NEWS:—The Albion Water-Works Co. began the construction of their works to supply Albion, N. Y., May 1, 1888 and have nearly finished them, Bassett Bros., this city, are the Engineers and Contractors for the works, and have sublet the masonry and foundations to Ward S. Bissell, Albion. Volker & Felthousen, Buffalo, furnish the pumps; R. D. Wood & Co., Philadelphia, the pipe and specials; the Ludlow Valve Mfg. Co., Troy, the valves and hydrants, and Riter & Conley, Pittsburg, the stand-pipe. Water is taken from flowing wells and pumped to a 250,000-gall. stand-pipe. There are two compound duplex pumps with a combined daily capacity of 2,000,000 galls. The service pipes are of wrought-iron and there will be 8 miles of cast-iron mains. The hydrant rental is $3,000 a year for 80 hydrants. E. M. BASSETT.

We have received from HENRY B. SMITH, M. Can. Soc. C.E., of Vancouver, B. C., a very full and interesting description of the works now under construction by the Vancouver Water-Works Co., Limited, for the supply of Vancouver. These works were designed by G. A. KEEFER, M. Inst. C. E., London, England, and are being constructed with Mr. SMITH as Resident Engineer. Capt. JNO. IRVING is President and J. W. MCFARLAND, Secretary of the Company, which has a capital stock of $250,000. All the contracts have been let except those for street trenching and it is expected that the works will be in operation by Nov. 1, 1888. The contractors for clearing, close cutting and grubbing are Stevenson & McCraney, Vancouver; for laying mains to city, Keefer (H. F.) & McGillivray, Vancouver; for delivering pipes to the city, Berry & Co., Vancouver; for the cast and wrought-iron distribution pipes, Welch, Rithet & Co., Victoria, B. C.; for steel mains and for valves and hydrants, Albion Iron Works Co., Limited, Victoria, B.C.

The source of supply is the Capilano river, a mountain stream with rapid fall. An impounding reservoir is formed by a timber dam loaded with boulders at a point about ten miles from the city. From this point water is conveyed by gravity to Vancouver, a submerged main being laid across Burrard Inlet and Coal Harbor Bay. The distribution system will have about 9¼ miles of pipe and 75 hydrants. A more extended description of these works will be given in the Manual.

RECORD OF NEW WATER-WORKS CONSTRUCTION.

(*Specially Communicated.*)

CONTINUED FROM PAGE 178.

Clarksburg, W. Va.—The works were commenced in June, 1888, and are to be completed in October, 1888, They were designed by JOHN W. HILL, M. E., of Cincinnati, O., who is also Constructing Engineer. The contractors are as follows: for pumping machinery, Deane Steam Pump Co., of Holyoke, Mass., by J. F. Osborn's Sons; for pipe and specials, R. D. Wood & Co., of Philadelphia, Pa.; for valves, Eddy Valve Co., of Waterford, N. Y.; for hydrants, Bourbon Copper & Brass Works, of Cincinnati, O.; for tanks, Cox & Morrison, of Wheeling, W. Va.; for trenching and pipe laying, R. B. Carothers, of Newport, Ky. The supply is taken from the West Fork of the Monongahela river and pumped to two steel tanks, 40 ft. diameter and 30 ft. deep, with a capacity of 280,000 galls. each, by two compound, duplex, direct acting pumping engines with a daily capacity of 500,000 galls. The engines pump against a head of 340 ft. There will be 6.5 miles of cast-iron mains, and 51 hydrants. Ordinary and fire pressure, 80 lbs. Cost of works, $50,000; for which bonds for $50,000 have been issued; rate of interest, 5 per cent. The works are owned by the town, and are managed by a Board of Water Commissioners, consisting of R. F. LOWNDES, T. M. JACKSON and J. B. HART. The present population is 3,000. (Date of special report; Aug. 10, 1888).

Concordia, Kan.—The works were commenced in June, 1887, and were to be completed in March, 1888; at the date of our special report, February 2, 1888, they were finished with the exception of the wells. They were designed by G. W. PEARSONS, of Kansas City, Mo., and D. L. GREGG, of Concordia, was Constructing Engineer, with L. D. MAY, of Lincoln, Neb., as Superintendent. The contractor was W. J. Cooper, of Lincoln, Neb. The buildings are of rubble masonry, on concrete foundations; Milwaukee cement was used. The pipes are of cast-iron, laid 5 ft. deep. The valves and hydrants were supplied by the Galvin Brass & Iron Works, of Detroit, Mich., and the pumping machinery by the Deane Steam Pump Co., of Holyoke, Mass. The supply is taken from the Platte river, at a point 300 ft. from the pumping station, and pumped to a stand-pipe 15 ft. in diameter by 75 ft. high, by a Deane pumping engine of 1,000,000 galls. daily capacity. There are 6 miles of pipe and 52 hydrants. The mains are of cast-iron; services of lead and iron. Ordinary pressure, 60 lbs.; fire pressure, 100 lbs. Cost of works, $45,000; debt, $45,000; rate of interest, 5 per cent. The works are owned by the city. The present population is 4,000.

(TO BE CONTINUED).